Volume 23, Number 13, July 15, 1969

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Division of Technical Information, Edward J. Brunenkant, Director, Published by the USAEC Divison of Technical Information Extension, Robert L. Shannon, Extension Manager.

Nuclear Science Abstracts (NSA) provides the only comprehensive abstracting and indexing coverage of international nuclear science literature. *Nuclear Science Abstracts* covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author (issuing organization), and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries:

Atomic Energy of Canada Limited
Danish Atomic Energy Commission
Finnish Atomic Energy Commission
Japan Atomic Energy Bureau-Atomic Energy Research Institute
Institutt for Atomenergi (Norway)
Aktiebolaget Atomenergi (Sweden)
United Kingdom Atomic Energy Authority

Abstracts for European patents are provided through special cooperation of the Netherlands Patent Office and the Institut International des Brevets.

Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications, e.g., in the United States the American Institute of Physics provides page-proof copy of its publications.

A list of the journals scanned regularly and the abbreviations used appears in Issue 1 (January 15) of each volume of *Nuclear Science Abstracts* and is supplemented in Issues 7, 13, and 19. Issue 1 of each volume also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

AVAILABILITY OF PUBLICATIONS ABSTRACTED

The latest public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations abstracted in *Dissertation Abstracts* and included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37830. In addition to the CFSTI availability cited in the Report Number Index, USAEC translations are also on deposit at the National Translation Center, John Crerar Library, Chicago, Illinois 60616.

HOW TO OBTAIN NUCLEAR SCIENCE ABSTRACTS

Nuclear Science Abstracts is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

For the 24 regular issues, the yearly rate is $42.00 for domestic subscribers and $52.50 for foreign subscribers. A single issue costs $1.75, domestic rates, or $2.19, foreign rates. Domestic rates apply to the United States, Canada, Mexico, and Central and South American countries except Argentina, Brazil, Guyana, French Guiana, Surinam, and British Honduras.

For a yearly subscription to the cumulative indexes, the rates are $38.00 for domestic subscribers and $47.50 for foreign subscribers.

The following multivolume indexes are available.

From Johnson Reprint Corporation, 111 Fifth Avenue, New York, N. Y. 10003:

Vols. 1–4, Subjects and Authors (1948–1950), $30.00.

From Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402:

Vols. 5–10, Subjects and Authors (1951–1956), $5.25.

Vols. 11–15, Subjects (1957–1961), $19.00.
Vols. 11–15, Personal Authors (1957–1961), $14.25.
Vols. 11–15, Corporate Authors (1957–1961), $2.50.

Vols. 16–20, Subjects (1962–1966), $36.00.
Vols. 16–20, Personal Authors (1962–1966), $22.50.
Vols. 16–20, Corporate Authors (1962–1966), $3.75.

Vol. 21, Subjects and Authors (1967), $16.00.

Cumulative Report Number Index, Vols. 1-15 Revised, $4.00.
Cumulative Report Number Index, Vols. 16-21, $4.25.

Nuclear Science Abstracts is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Government agencies may obtain *NSA* free of charge. Inquiries should be directed to the USAEC Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37830.

INDEXES TO NSA

Comprehensive indexes appear in each issue and are cumulated semiannually and annually. Multivolume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Technical report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summary below.

Index References

All index entries refer the reader to volume and abstract number:

```
FOURRIER, Alain
  Radioactive chain of mass number 189,  21:10023
```

Personal Authors

Every author's name is indexed in the form appearing on the document abstracted:

```
MONTH, M.
  Theory of gradient perturbations in AGS,  21:9872 (BNL-
    10899)
MONTH, Melvin
  Simple relativistic calculation of the electromagnetic
    form factors of the deuteron,  21:9744
```

Subjects

The subject index consisting of specific materials, objects, and processes is arranged alphabetically. Modifying phrases specific to these subjects in turn are arranged alphabetically under the subjects.

```
SHEEP
  radiation dosimetry in, measurement of lethal dose of x,
    21:8905(R) (AD-631189)
  radiosensitivity of hematopoietic system of, x,
    21:8905(R) (AD-631189)
```

```
SHELTERS
  construction of, for civil defense,  21:8838
  design of fallout,  21:8777(R) (AD-629736)
  design of shaft closure for,  21:8563(P)
  determination of configuration of, for ventilation,
    21:8779(R) (AD-629928)
  equipment for fallout, minimal requirements of,
    21:8782(R) (AD-631424)
  evaluation of fallout, for fire and air blast damage,
    21:8560 (URS-658-3)
  fire resistance of components of, evaluation of,
    21:8789(R) (AD-642241)
```

Corporate Authors

Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

8500 (Y-1561) MIXING AND SAMPLING ENRICHED ^{235}U FLUIDS IN CYLINDRICAL STORAGE CONTAINERS. Final Report. Harrell, J. E. **(Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant).** Jan. 17, 1967. Contract W-7405-eng-26. 124p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

is indexed as:

```
UNION CARBIDE CORP., OAK RIDGE, TENN.  Y-12 PLANT.
  Mixing and sampling enriched 235U fluids in cylindrical
    storage containers,  21:8500 (Y-1561)
```

Report Numbers

Technical report literature is also indexed by report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

```
TID-
  3311(Suppl. 2)  21-8567   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  22298           21-9915   Nucl. News, 9: No. 12, 17-21 (Dec.
                              1966)
  22298           21-9914   Nucl. News, 10: No. 1, 17-20(Jan.
                              1967)
  23267           21-9702   Phys. Rev., 152: 1171-82(Dec. 23,
                              1966)
  23287           21-8498   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23420           21-8764   Lancet, 2: 672-5(Sept. 24, 1966)
  23474           21-8528   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23478           21-8641   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23482           21-9471   Dep. mn. CFSTI $3.00 cy, $0.65 mn
```

Volume 23, Number 13 July 15, 1969

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 24214, 24481, and 25153.

24063 DETERMINATION OF PLUTONIUM. Cauchetier, Ph (CEN, Fontenay-aux-Roses, France). Chim. Anal. (Paris), 50: 409-13(Aug. 1968). (In French).

The principal methods applicable to Pu analysis may be divided into physical methods (radiometry or mass spectrometry), spectrophotometric methods (absorption of the element itself, absorption of complexes with Arsenazo I, Thoron, or Na alizarinsulfonate), gravimetric methods (PuO_2, benzenesulfinate, sulfate tetrahydrate, or double chloride with Cs), complexometric methods (EDTA), and methods employing the redox properties of Pu (oxidation of Pu(III) to Pu(IV) or reduction of Pu(VI) to Pu(IV)), and controlled-potential coulometry. Other less convenient methods are also available. Small systematic errors aside, the relative error for a typical method is near 0.5%. Spectrophotometric methods are particularly interesting in terms of automated analyses. (BBB)

Chemical Procedures

Refer also to abstract 24284.

24064 (BARC-383) SPECTROGRAPHIC ANALYSIS OF SOME RARE EARTHS AND ACTINIDES IN PLUTONIUM. Joshi, B. D.; Saxena, R. N.; Patel, B. M.; Bangia, T. R.; Page, A. G. (Bhabha Atomic Research Centre, Bombay (India)). 1968. 26p. Dep.

An emission spectrographic method for determination of rare earths (cerium, samarium, europium, gadolinium, dysprosium, erbium, lutetium) and actinides (uranium and americium) in plutonium using a dc arc was developed. The rare earths and actinides are separated from plutonium by anion exchange at 7.2M HNO_3. The effluent containing impurities is concentrated to 200 μl. Lanthanum was used as a matrix element and thulium as an internal standard. The estimation ranges by this procedure are: rare earths, 0.2 to 4.0 ppM; americium, 2 to 40 ppM; and uranium 10 to 200 ppM and the average standard deviation is 15%. Since other impurities from plutonium are also carried along with rare earths in the effluent, the effects of some commonly occurring impurities on the intensity ratios of rare earth analyses lines were investigated. (auth)

24065 (NP-17815) RAPID AND SIMPLE METHOD FOR THE DETERMINATION OF TRIBUTYL PHOSPHATE IN KEROSENE SOLUTIONS. Markl, P.; Humblet, L.; Eschrich, H. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). June 1968. 23p. (ETR-225). Dep.

A method for the determination of the vol % of tributyl phosphate (TBP) in kerosene solutions was developed. The determination is based on the third phase formation in the TBP–kerosene–H_2O–$HClO_4$ system. Equilibration of TBP–kerosene samples with perchloric acid leads to the formation of two organic phases. The volume of the heavier organic phase, consisting predominantly of TBP · $HClO_4$, can be related to the TBP content in the original sample. The method described is applicable to samples containing from 5 to 75 vol % TBP. A precision of ±1 vol % (absolute) TBP at the 95% confidence level was obtained for the range 10 to 75 vol % TBP. The analysis can be carried out within 5 minutes. (auth)

24066 (UCRL-50569) PRELIMINARY STUDIES IN NONDISPERSIVE X-RAY FLUORESCENT ANALYSIS OF BIOLOGICAL MATERIALS. Cranston, Fred P.; Anspaugh, Lynn R. (California Univ., Livermore. Lawrence Radiation Lab.). Jan. 6, 1969. 18p. Dep. CFSTI.

Initial efforts to use a Ge(Li) detector for the nondispersive x-ray fluorescence analysis of biological samples are described. The judicious use of collimators was found to greatly improve sensitivity. For barium in a cellulose matrix the limit of detection was about 20 μg with a counting time of 650 minutes, and with the use of a 3 Ci ^{241}Am source. The presence of scattered background radiation was found to be the limiting factor. Further improvement may be expected by improving the geometry, but not by increasing the source strength. (auth)

24067 ANALYSIS OF RADIOACTIVE METALS BY SPARK SOURCE MASS SPECTROMETRY. Johnson, A. J.; Kozy, A.; Morris, R. N. (Dow Chemical Co., Golden, Colo.). Talanta, 16: 511-18(Apr. 1969).

A spark source mass spectrograph with photographic plate recording was adapted for the analysis of plutonium and americium metals. Over seventy elements could be determined simultaneously in these metals. A comparison was made between results obtained by mass spectrography and by conventional methods for impurity elements. The operations involved in handling radioactive materials in the mass spectrograph are discussed. (auth) (UK)

24068 EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION OF MICROGRAM QUANTITIES OF COBALT IN VARIOUS MATERIALS WITH ZINC DIETHYLDITHIOCARBAMATE. Motojima, Kenji; Tamura, Nori (Japan Atomic Energy Research Inst., Ibaraki). Anal. Chim. Acta, 45: 327-32(Apr. 1969).

Cobalt is extracted with a benzene solution of zinc diethyldithiocarbamate. The excess of reagent and metals such as copper and nickel extracted with cobalt are removed by washing the organic phase with potassium cyanide solution. Other metals such as bismuth and lead are replaced by copper by shaking the organic phase with copper sulfate solution; the copper in the organic phase is removed by potassium cyanide solution. The absorbance of cobalt diethyldithiocarbamate in the organic phase is then measured at 325 nm. Down to 1 μg of cobalt in a few grams of uranium, thorium, aluminum, beryllium and zircaloy can be readily determined. (auth)

24069 CATHODE-RAY-EXCITED EMISSION SPECTROSCOPIC ANALYSIS OF TRACE RARE EARTHS. PART III. DETERMINATION OF TERBIUM. Larach, Simon; Shrader, Ross E. (RCA Labs., Princeton, N. J.). Anal. Chim. Acta, 45: 227-32(Apr. 1969).

The technique of trace analysis of rare earths by cathode-ray-excited emission spectroscopy was applied to the determination of terbium in an yttrium oxide matrix. With the 544-nm emission from terbium as the detection wavelength, and with high-resolution spectrometry, a detection limit of about 2 ppB can be attained. The effect of sample firing temperature during diffusion and crystallization is treated in detail. Effects of other rare earth and first transition group interferences are discussed. (auth)

24070 APPLICATIONS OF ELECTRON SPIN RESONANCE TO GAS-PHASE KINETICS. Westenberg, A. A. (Johns Hopkins Univ., Silver Spring, Md.). Science, 164: 381-8(Apr. 25, 1969).

Electron spin resonance spectroscopy is shown to be a reliable and versatile means for quantitative detection of a variety of free atoms and simple radicals. Coupled with carefully controlled fast flow reactors, the use of this technique in many cases allows the rates of elementary chemical reactions to be determined with unprecedented reliability. (auth)

24071 CHEMICO-SPECTRAL METHOD OF ANALYZING HIGH-PURITY ANTIMONY, THE BASE BEING DISTILLED IN THE FORM OF ANTIMONY TRIBROMIDE. Malakhov, V. V.; Protopopova, N. P.; Trukhacheva, V. A.; Yudelevich, I. G. Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk, 4: No. 9, 78-83 (July 1968). (In Russian).

An improved chemico-spectral method of analyzing high-purity Sb in which the impurities are concentrated on the C collector by distilling the base in the form of $SbBr_3$ is described. The efficiency of impurity concentration depends to a great extent on the temperature the period of distillation, and related factors; residual Sb in the impurity concentrate may also have an effect on the spectral analysis. The method is very suitable for determining Ag, Au, Ba, Be, Ca, La, Mg, Mn, Pb, Pt, Tl, Fe, In, Ga, Al, Cd, Zn, Cu, Co, Ni, and Cr. The sensitivity is 10^{-7} to 10^{-5}% and the reproducibility 15 to 40%. (Metals Abstr.)

24072 POLARIZATION TITRATION WITH TWO POLARIZABLE ELECTRODES. 2. DETERMINATION OF CERIUM IN YTTRIUM OXIDE WITH A PAIR OF GLASSY CARBON ELECTRODES. Nakashima, Ryozo; Furukawa, Masamichi (Government Industrial Research Inst., Nagoya, Japan). Nagoya Kogyo Gijutsu Shikensho Hokoku, 17: 235-40(Oct. 1968). (In Japanese).

The differential polarographic titration of cerium with standard hydroquinone solution was studied and applied to the determination of cerium in yttrium oxide. The titers of 0.01 N and 0.001 N hydroquinone solutions each containing 0.01 M H_2SO_4 were unchanged for at least 30 days. The condition for obtaining the most profitable titration curve using a pair of glassy carbon electrodes (each 0.07 cm^2 in area) was: current 0.5 to 1.0 μA and titration speed 0.2 ml/min near the end point. Under these conditions, 10 mg to 20 μg of cerium were determined with good reproducibility in a wide range of concentration of H_2SO_4 or HNO_3. One tenth amount of permanganate did not interfere, but, beyond this value, the titrant consumed was decreased. One tenth amount of chromate, one half amount of vanadate did not interfere. W(VI), Mo(VI), Fe(III), Ti(IV), and Th(IV) of the same amount did not interfere. Among several oxidation methods, the oxidation with PbO_2 in 2 to 3 M HNO_3 was found to be most suitable. (NSA of Japan)

24073 CHEMISTRY OF PLUTONIUM WITH SPECIAL REFERENCE TO ITS ANALYSIS. Schmid, E. (Eurochemic, Mol, Belgium). Oesterr. Chem.-Ztg., 68: 329-35(1967). (In German).

A summary of the chemical, spectral, and electrochemical properties of Pu is followed by a brief description of methods used for separation and analysis. (Anal. Abstr.)

24074 POLARIZED-LIGHT SPECTROMETRIC DETERMINATION OF METALS OF THE LANTHANUM SERIES BY ROTATORY MAGNETIC DISPERSION. Briat, B.; Badoz, J. Method. Phys. Anal., 181-2(Oct.-Dec. 1967). (In French).

The rotatory magnetic dispersion spectra of these tervalent metal ions show certain Cotton effects (variation in angle of rotation with wavelength) that are specific for each element, the amplitude of the effect being proportional to the concentration of ions in solution. The magnetic rotatory power of the sample solution, containing a mixture of the ions in trace amounts, is measured with a sensitive spectropolarimeter. Except when Tm(III) is being determined, this rapid method has a sensitivity of 2 to 3 mg of the metal oxide per litre and has the advantages over absorption spectrophotometry that the induced rotation can be positive or negative depending on the spectral region scanned, and supplementary qualitative information is obtainable because the absorption band of the specific ion corresponds to one of the four standard curves characterising the Cotton effect. (Anal. Abstr.)

24075 NEW DISTURBANCE-FREE VOLUMETRIC IODIDE DETERMINATION IN THE FEMTOGRAM REGION BY CATALYTIC OXIDATION OF TETRABASE. Baliczo, H. (Univ., Vienna). Monatsh. Chem., 99: 2480-93(Nov.-Dec. 1968). (In German).

Stabilization of the blue color formed in the iodide-ion-catalyzed oxidation reaction of the tetramethyl base was employed for a quantitative determination of very small amounts of iodide ions in water and some salts. The blue oxidation product can be assayed by titration with 0.001 N-$Na_2S_2O_3$ to discoloration. The method permits the determination of essentially smaller amounts of iodide ion (femtograms) than can be determined radiochemically (nanograms). (auth)

24076 CHLORINE ISOTOPIC RATIOS BY NEGATIVE ION MASS SPECTROMETRY. Taylor, James W.; Grimsrud, Eric P. (Univ. of Wisconsin, Madison). Anal. Chem., 41: 805-10(May 1969).

For kinetic isotope effect studies the determination of the relative isotopic abundances of ^{35}Cl and ^{37}Cl can be accomplished directly on gaseous methyl chloride samples by comparison of the Cl^- ion intensities with a conventional isotope-ratio mass spectrometer equipped for negative ion operation. Procedures for the conversion of inorganic chloride samples to gaseous methyl chloride were examined to ensure isotopic identity of the methyl chloride from the chloride precursor. Because relative rather than absolute abundances are required for this application, rapid switching between sample and standard is used to compensate for instrument drift and background. A comparison between positive and negative ion ratios revealed several advantages to be gained by the negative ion technique. (auth)

24077 COULOMETRIC DETERMINATION OF BARIUM, AND ITS SEPARATION FROM STRONTIUM BY CONTROLLED-POTENTIAL ELECTROLYSIS. Lingane, J. J. (Harvard Univ., Cambridge, Mass.). J. Electroanal. Chem., 15: 211-20(1967).

The determination of Ba in the presence of Sr was carried out by controlled-potential coulometry at a mercury-pool cathode (area ≈ 5 sq cm) in a supporting electrolyte of 0.1 M-tetraethylammonium iodide. The optimum conditions, established from polarographic measurements, showed that Ba gave a well-defined wave ($E_{1/4}$ at −1.93 V vs. the S.C.E.) well separated from the wave for Sr ($E_{1/4}$ at −2.13 V), which showed a pronounced maximum. With an applied potential of −2.03 V vs. the S.C.E., the average deviation for seven samples containing Ba (0.4 to 1.5 millimoles) was ±1.4. The use of controlled-potential coulometry for the separation of large amounts of Ba before the polarographic determination of Sr was demonstrated. (auth)

24078 TRACING WATER POLLUTION WITH AN EMISSION SPECTROGRAPH. Kopp, J. F.; Kroner, R. C. (Federal Water Pollution Control Administration, Cincinnati). J. Water Pollut. Contr. Fed., 39: 1659-68(1967).

A surveillance program to ascertain chemical and biological trends in water quality has been in operation since 1957 and has involved the use of a direct-reading emission spectrograph for determining the concentration of 19 trace elements (Zn, Cd, As, B, P, Fe, Mo, Mn, Al, Be, Cu, Ag, Ni, Co, Pb, Cr, V, Ba and Sr) at 131 sampling points located on main waterways throughout the U.S.A. Results are given for several small rivers, and the effects of acid mine drainage, particularly from coal mines, are discussed. (Anal. Abstr.)

24079 8-HYDROXY-7-IODOQUINOLINE-5-SULPHONIC ACID (FERRON) AND 8-HYDROXYQUINOLINE-5-SULPHONIC ACID AS REAGENTS FOR THE POLAROGRAPHIC DETERMINATION OF MOLYBDENUM. Bertoglio Riolo, C.; Fulle Soldi, T.; Occhipinti, C. (Univ. Pavia, Italy). Ann. Chim. (Rome), 57: 1344-51(1967). (In Italian).

Conditions for the determination of Mo with each reagent were studied, and the complexes were examined spectrophotometrically to establish their composition. 8-Hydroxyquinoline-5-sulfonic acid is preferred as chelating agent, and in the presence of hydrazine the complex gives a single polarographic wave (instead of the two given in the absence of a reducing agent). In acetate buffer medium of pH 4 to 4.1, Mo(V) gives a well-defined wave ($E_{1/4}$ = −0.63 vs. the S.C.E.). The presence of V or W is tolerated, provided that the molar ratio of V to Mo is <3 : 1 and that of W to Mo is <1 : 1. (Anal. Abstr.)

24080 ABSORPTIOMETRIC DETERMINATION OF IODINE IN WATER. Shveikina, R. V. Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol., 10: 1288-9(1967). (In Russian).

A method is described for the absorptiometric determination of iodine in water that involves making the sample alkaline with K_2CO_3, evaporating to dryness on a water bath, igniting the residue at 450°C for 30 min, adding KCl, $NaNO_2$, methyl violet, toluene, and H_3PO_4, and then measuring the extinction of the extract (containing the ion-association complex of I_2Cl^- with the methyl violet cation) using a green filter or at 500 nm (5-mm cell). In determining 0.8 to 1.1 μg of I^- the error was < 0.2 μg. (Referativnyi Zh)

24081 COULOMETRIC TITRATION OF SELENIUM(IV) AND TELLURIUM(IV) USING ELECTROLYTICALLY GENERATED TIN(II). Agasyan, L. B. ; Nikolaeva, E. R.; Agasyan, P. K.; Lebedeva, Z. M. Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol., 10: 1315-19(1967). (In Russian).

From curves of I vs. E, the optimum conditions are found for the generation of Sn^{2+} at a platinum electrode with the maximum current efficiency (≃98%) in the determination of Se(IV) and Te(IV) in a basal solution of 6N–HCl; the $SnCl_4$ concentration should be >0.8 M, and the cd > 1.5 mA per sq cm. In the coulometric titration of traces of Se and Te, use is made of potentiometric or photometric indication of the end-point. The potentiometric variant can be used to determine Se and Te when both are present. The sensitivity of the method is ≃0.8 μg of Se and ≃1.3 μg of Te per ml. In the presence of Fe(III) two inflections of potential are observed. The results obtained for Se or Te from the first inflection are somewhat high. (Referativnyi Zh.)

24082 SPECTROPHOTOMETRIC DETERMINATION OF THORIUM WITH CHROMAZUROL S AND CETYLTRIMETHYLAMMONIUM CHLORIDE. Shijo, Yoshio; Takeuchi, Tsugio (Univ. of Utsunomiya, Japan. Univ. of Nagoya, Japan). Bunseki Kagaku, 18: 469-73(Apr. 1969). (In Japanese).

Chrome Azurol S reacts with thorium to form a blue association complex in aqueous pyridine in the presence of cetyltrimethylammonium chloride (CTMAC). The absorption maximum at 631 mμ of the complex is almost independent of the reagent concentration and the pH of the solution, and the absorbance is nearly constant at pH 5.6 to 6.1. The sensitivity is very high, the molar absorptivity being 1.74×10^5 for 0.78 μg Th/ml solution. Beer's law is not obeyed, but the calibration line is linear for 0.15 to 0.8 μg/ml. The complex is assumed to have 1:4 (Th:CAS) composition. V, Mo, Zr, W, Cu, Au, Cr, U, As, Sn, Ga, Bi, Hf, Ti, Al, Be, and Fe interfere seriously. The recommended procedure for obtaining a calibration line is as follows. To the solution containing 4 to 40 μg Th in a 100 ml beaker is added 1.7 ml of 2M nitric acid, and it is made to about 25 ml with water. One milliliter of 0.5% CTMAC is added and the solution agitated. Five milliliters of 0.02% CAS is added by dipping the tip of a pipet into the liquid on the vessel wall, and then similarly 5 ml of 4M pyridine. After being allowed to stand for 5 min, the solution is transferred into a volumetric flask and made up to 50 ml with water. The absorbence at 631 mμ is measured after 10 min. The pH of the final solution is 5.9. (auth)

24083 DETERMINATION OF TRACES OF FLUORIDE IN TANTALUM BY PYROLYTIC SEPARATION–ALIZARIN COMPLEXONE EXTRACTION SPECTROPHOTOMETRY. Hirano, Shizo; Fujinuma, Hiroshi; Yoshida, Yoshihiko; Makita, Yukitoshi (Toyo Univ., Saitama, Japan). Bunseki Kagaku, 18: 516-19 (Apr. 1969). (In Japanese).

A method for determining traces of fluoride in tantalum metal powder using pyrolytic separation and alizarin complexone extraction spectrophotometry was established. A half gram of sample is mixed with 1 g of uranium oxide (U_3O_8) by grinding, and the mixture is transferred into a porcelain boat. Pyrolysis is carried out under a stream of moist nitrogen (for 10 min) followed by moist oxygen (for 5 min) in a fused silica combustion tube (about 1100°C). The volatilized fluoride is absorbed in 20 ml of dilute sodium hydroxide solution. This solution is transferred to a separatory funnel, and 20 ml of combined lanthanum–alizarin complexone reagent solution added. Extraction is made with 10 ml of 5 vol % N,N-diethylaniline in isoamyl alcohol by shaking for 3 min, and the two layers are allowed to separate by standing. After the drainage of the aqueous layer, the organic layer is washed with 50 ml of acetate buffer solution. The absorbence of the organic layer is measured at 580 mμ using a reagent blank as a reference. (auth)

24084 ATOMIC-ABSORPTION SPECTROSCOPY AND ANALYSIS BY ATOMIC-ABSORPTION FLAME PHOTOMETRY. Ramirez-Munoz, Juan. New York, American Elsevier Publishing Company, Inc., 1968. 502p. $28.50.

Such fundamentals as origin, nomenclature, and theory, general principles and characteristics, and comparisons of atomic absorption spectroscopy with other instrumental methods are discussed. Instrumental systems, including emission, absorption, selection, and photometric systems, are considered in detail. Experimental methods, their range, limitations, and applications are also included. (950 references). (J.G.B.)

24085 AMPEROMETRIC DETERMINATION OF CERIUM IN STEELS AND CAST IRONS. Henriet, D.; de Gelis, P. (Institut de Recherches de la Siderurgie, Paris). Chim. Anal. (Paris), 50: 519-30(Oct. 1968). (In French).

The chief methods for determination of Ce in steels and a new electroanalytical technique are discussed. Older methods are spectrophotometric techniques with Ce(III) and Ce(IV) and electrochemical procedures based on potentiometry and polarography. The electrochemical technique is based on oxidation of a pyrophosphate complex of Ce(III) by $KMnO_4$. An apparatus is described, and variables are studied to optimize the experiment: pH, reagent purity, interferences by several elements. The method allows distinction of Ce from the other lanthanides, and is adaptable to low concentrations of Ce. The lowest steel tested was 61-01-13, which gave Ce contents from 0.014 to 0.017% by the method. Inconveniences include use of dilute permanganate solutions and the necessity for complete separation of Mn. The separation of Ce from contaminating ions (notably Mn, V, Co) is achieved with HCl–acetone on an ion exchange column. (BBB)

24086 TITRIMETRIC MICRODETERMINATION OF SAMARIUM AND NEODYMIUM. Saxena, O. C. (Univ. of Allahabad, India). Chim. Anal. (Paris), 50: 638-40(Dec. 1968). (In French).

Microquantities of Sm and Nd were determined by adding a known excess of $K_4Fe(CN)_6$ at room temperature. Conductimetric titrations indicate formation of $KSmFe(CN)_6$ and $KNdFe(CN)_6$. The complex is filtered and washed, and the filtrate and washings are titrated with $Ce(SO_4)_2$ in 8N H_2SO_4 with N-phenylanthranilic acid as indicator. For amounts between 1 and 5 mg/l the error is 2.1% (maximum). There is no interference by Ca, Sr, Ba, Ru, Rh, Ir, W, Mg, and Zr; however, Ag, Tl, Zn, Be, Sn, Sb, Cu, Fe, Co, Ni, Bi, Te, Os, Se, U, Cr, In, Pt, and Au interfere. A procedure is given, and a table of experimental results shows average errors of 1.5% for Sm and 0.5% for Nd. (BBB)

24087 CONTROLLED-POTENTIAL COULOMETRIC DETERMINATION OF AMERICIUM. Stokely, J. R. Jr.; Shults, W. D. (Oak Ridge National Lab., Tenn.). Anal. Chim. Acta, 45: 417-24(May 1969).

Controlled-potential coulometry was studied as a means for the precise and accurate determination of americium. Americium is chemically oxidized to the hexavalent state, and then coulometrically reduced from Am(VI) to Am(V) at a platinum electrode controlled at 1.05 V vs. S.C.E. Results of repetitive analysis of standard solutions prepared from high-purity americium-243 dioxide agree within a few tenths percent with standard values for 0.4 to 1.3 mg of americium. (auth)

24088 A COMBINED ANION EXCHANGE: SPECTROGRAPHIC PROCEDURE FOR THE DETERMINATION OF TRACE AMOUNTS OF Sm, Eu, Gd, AND Dy IN THORIUM COMPOUNDS OBTAINED FROM MONAZITE. Edge, R. A. (Univ. of Reading, Eng.). J. S. Afr. Chem. Inst., 21: 127-35(Oct. 1968).

Thorium oxalate and Th tetrafluoride are produced from monazite by a solvent extraction procedure. The high thermal-neutron cross sections of Sm, Eu, Gd, and Dy make it necessary to maintain analytical control of these rare earth impurities in the above Th compounds obtained from monazite. A method is described for the determination of trace amounts of Sm, Eu, Gd, and Dy in the Th compounds. After conversion of the compounds into Th nitrate via ignition into Th oxide, anion exchange in 8N HNO_3 was used to separate Th from the rare earths plus added Y carrier. A d-c arc spectrographic procedure employing Y as internal standard was used for determining Sm, Eu, Gd, and Dy in the rare earth Y residue obtained from the anion exchange step. These Th compounds contained an average of 50 ppM Sm, 7 Eu, 25 Gd, and 10 Dy; Ce (500 ppM), La (190), Nd (200), Pr (55), and Er (3) were also present. (BBB)

24089 SPECTROCHEMICAL DETERMINATION OF SOME NON-RARE EARTH IMPURITIES IN YTTRIUM OXIDE. Muntz, James H. (Air Force Materials Lab., Wright-Patterson AFB, Ohio). Spectrochim. Acta, Part B, 24: 207-14(Apr. 1969).

Yttrium was used to produce a stabilized zirconium oxide with unique properties. The impurity level of the yttrium compounds used in the preparation of this material is very important since the impurities will concentrate in the grain boundaries, reducing the strength and high temperature properties of the finished product. Two spectrochemical techniques were developed for the determination of 26 nonrare earth impurities in yttrium oxide. The first technique, involving a direct burn, is used for the more refractory elements and higher impurity concentration levels. The other technique, involving carrier distillation, is used for some of the more volatile elements and concentration levels to 1 ppM or less for 18 elements. The average relative standard deviations were about 10% and the average overall deviations from known concentrations were about 12% for both techniques. (auth) (UK)

24090 NEW PHOTOMETRIC METHODS OF DETERMINING ACTINIDES. Nemodruk, A. A.; Palei, P. N. pp 144-56 of Sovremennye Metody Analiza, Metody Issledovaniya Khimicheskogo Sostava i Stroeniya Veshchestv. Moscow, Izdatel'stvo Nauka, 1965. (In Russian).

Data are presented and discussed that show that the sensitivity of photometric methods in the determination of Th, Pa, U, Np, and Pu with Arsenazo III and Chlorophosphonazo III exceed the sensitivity of other reagents by almost one order of magnitude. Furthermore, the sensitivity may be consider-

ably increased by preliminary concentration by extraction, coprecipitation, or chromatographic methods. It is noted that the high sensitivity of the new photometric methods of determination is accompanied by a high degree of selectivity. The ability of Arsenazo III and Chlorophosphonazo III to react with actinide elements in highly acid solutions has great advantages over other methods since hydrolysis is completely excluded under these conditions. Other advantages of the method include simplicity and the resultant short duration of the process, in some cases lasting no more than 5 to 7 minutes. The advantages of the new photometric methods presented indicate possibilities of their application in various stages in the search and production of actinide elements, particularly in the automatic control of the production of nuclear fuel. (ATD)

24091 ANALYTICAL CHEMISTRY OF LESS-COMMON OXIDATION STATES. VII. SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM WITH 1,10-PHENANTHROLINE. Lucena-Conde, F.; Vicente-Perez, S.; Moran, L. Leon (Univ., Salamanca, Spain). Inform. Quim. Anal., Pura Apl. Ind., 21: 202-7(1967). (In Spanish).

On treatment of a solution containing Mo^{6+} with 1,10-phenanthroline (I) in the presence of $SnCl_2$ and HCl, a red–violet complex of the composition $IMo^{V}Mo^{VI}$ is formed. This complex can be used for the spectrophotometric determination of Mo (1 to 500 μg) at 500 nm. A similar complex, but of less intense colour, is formed with 2,2′-bipyridyl. (Anal. Abstr.)

24092 DETERMINATION OF PLUTONIUM BY CONTROLLED-CURRENT COULOMETRY. Stokely, J. R. Jr.; Shults, W. D. (Oak Ridge National Lab., Tenn.). Anal. Chim. Acta, 45: 428-32(May 1969).

A method for determination of plutonium by titration with iron(II) or cerium(IV) is described in which the reagents are generated coulometrically from the dual intermediates, Fe(III) and Ce(III). Relative standard deviations of 0.1 to 0.5 in the 1 to 5 mg range were obtained by this method of indirect titration. (M.C.G.)

24093 AN IMPROVED TITRIMETRIC METHOD FOR THE DETERMINATION OF URANIUM: OXYGEN RATIOS. Dharwadkar, S. R.; Chandrasekharaiah, M. S. (Bhabha Atomic Research Centre, Bombay). Anal. Chim. Acta, 45: 545-6(May 1969).

A titration method in which cerium(IV) sulfate was used as an oxidant is described. The uranium oxide samples were weighed and mixed with a known excess of 0.1 M $Ce(SO_4)_2$ in 3 N H_2SO_4. The excess Ce^{4+} was titrated with a freshly prepared standard iron(II) ammonium sulfate solution using ferroin as the indicator. A standard deviation of ±0.0032 for 15 determinations of the O/U ratio was obtained. (M.C.G.)

Isotopic Procedures

24094 USE OF MASS SPECTROMETRY FOR TRACE ANALYSIS IN SOLIDS. Aulinger, Fritz. pp 130-50 of Die Analytische Chemie in der Erzeugenden und Verarbeitenden Huettenindustrie, 1968. (In German).

The isotope dilution method is briefly discussed and the vacuum-spark technique, which is rapid, detects all elements in the ppM range, but is only of moderate accuracy, is discussed in detail. Applications for the determination of trace elements in steel, Al, Be, and GaAs are reported. (Metals Abstr.)

24095 A MASS SPECTROMETRIC METHOD FOR DETERMINATION OF SUBNANOGRAM QUANTITIES OF ^{237}Np. Landrum, Jerry H.; Lindner, Manfred; Jones, Nancy (Univ. of California, Livermore). Anal. Chem., 41: 840-2(May 1969).

A method for determining ^{237}Np by the isotopic dilution technique is reported using ^{235}Np and a long lived isomer of ^{236}Np as mass diluents. Neptunium-235 and ^{236}Np were prepared by high-intensity deuteron irradiation of highly purified isotopically enriched ^{235}U. The produced ^{235}Np and ^{236}Np were isolated by thorough exhaustive radiochemical purification steps. Nine solutions ranging in concentration from 0.01 to 0.05 mg ^{237}Np per ml were analyzed by mass spectrometric (M.S.) methods and by neutron activation (N.A.) methods. Two independent sets of results from the M.S. method, one based upon ^{235}Np and the other on ^{236}Np concentration, and results from N.A. method are tabulated. The time required to obtain results for the N.A. method varied from two weeks to a month depending on starting conditions of the initial solution. By the M.S. method, results were easily obtained within 4 or 5 days. (D.H.M.)

24096 CALCULATION OF PRECISION IN ISOTOPE DILUTION EXPERIMENTS. . Coulter, B. S. (Agricultural Inst., Wexford, Ireland). Int. J. Appl. Radiat. Isotop., 20: 271-4(Apr. 1969).

Equations were derived for the composite error of isotope dilution measurements in three types of experiment, viz. simple dilution, saturation analysis (sub-stoichiometric dilution) and adsorbed ion measurement, the latter two yielding equations of the same form. Errors for each type were derived in terms of radiometric errors, chemical errors, and a factor related to the extent of isotope dilution. In general, dilution is the most critical factor which controls error; chemical errors are usually less important than radiometric errors. A nomogram for calculating dilution errors is given. (auth) (UK)

24097 A GENERAL FORMULA FOR DOUBLE ISOTOPE DILUTION ANALYSIS. Boelrijk, N. A. I. M. (Organisation for the Advancement of Pure Research, Amsterdam). Chem. Geol., 3: 323-5(Dec. 1968).

A general expression is derived for the evaluation of mass discrimination in double isotope dilution analysis. For illustration the formula is applied to Sr analysis. In the standard procedure of dating rocks and minerals by the Rb–Sr method using mass spectrometric isotope dilution techniques, Sr contents are generally measured by addition of a spike highly enriched in ^{84}Sr. Most calculation schemes and computer programs used to evaluate the mass spectrometric data using this ^{84}Sr spike require calculation of successive approximations. This iteration method is tedious and time consuming. The principle and general formulas for evaluation of mass discrimination are presented. From measurements on Sr it was concluded that the well-known square-root-of-mass correction is a suitable one for the conditions of measurement employed, using multiplier detection. (BBB)

Radiometric Procedures

Refer also to abstracts 24405, 24450, 24451, and 24479.

24098 (CONF-670649-36) APPLICATION OF TRACERS IN ANALYTICAL CHEMISTRY. DETERMINATION OF THE YIELD IN THE SEPARATION OF IONIUM (^{230}Th) IN URANIUM MINERALS. Galiano Sedano, J. A.; Acena Barrenechea, M. L. (Junta de Energia Nuclear, Madrid (Spain)). [1967]. 10p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

For determination of ^{230}Th in minerals and residues from the processing of U by a method consistent with hydrofluoric acid precipitation separation, using lanthanum as a carrier, and selective extraction with thenoyltrifluoroacetone, followed by radiometric determination of the nuclide separated, it is necessary to use a tracer because the chemical yield of the separation varies within wide limits. Use of ^{234}Th as the tracer was studied. Some expressions to correct the errors introduced by other Th isotopes and to calculate the chemical yield of the separation are deduced. The results are compared experimentally with determinations made in different types of samples. (tr-auth)

24099 (COO-1198-621) X-RAY MASS ABSORPTION COEFFICIENTS AND QUANTITATIVE MICROANALYSIS OF METALLURGICAL SYSTEMS, INCLUDING REFRACTORY METAL-INTERSTITIAL COMPOUNDS. Gray, Lawrence John (Illinois Univ., Urbana). Feb. 1969. Contract AT(11-1)-1198. 231p. Dep. CFSTI.

Thesis.

A method, based on consideration of atomic potentials, for the estimation of mass absorption coefficients is described. Mass absorption coefficients for wavelengths up to 80 Å can be estimated. Numerical values are given for several elements, including the refractory metals, for the characteristic emission lines of carbon, nitrogen, and oxygen. The method of calculation permits the estimation, to better than 5% in most cases, of mass absorption coefficients. A correction procedure for the conversion of microprobe x-ray intensity data to composition is presented. The method, implemented by a described computer program, was tested in the analysis of eight metallurgical systems containing elements from carbon to gold in various combinations. The data reduction computation has been shown to be generally applicable to this variety of elements. The greatest difficulties were encountered in the analysis of carbon containing samples. Consideration of the principles on which the correction relations rest led to the definition of a set of analytical conditions which minimize the theoretical errors. (auth)

24100 (LA-DC-9757) NEUTRON INTERROGATION AND DELAYED NEUTRON ASSAY OF FISSIONABLE MATERIAL SCRAP. Thorpe, M. M.; Henry, C. N.; Smith, Darryl B. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 6p. (CONF-681101-28). Dep. CFSTI.

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C.

The delayed neutron leakage from a simulated 55-gallon scrap barrel was calculated using the LASL one-dimensional DTF-IV transport code. If large amounts of hydrogenous materials are present, the greatly enhanced delayed neutron response may be reduced considerably by normalizing to a fission chamber monitor containing the fissile species of interest. (M.C.G.)

24101 (LA-DC-9758) DELAYED NEUTRON KINETIC RESPONSE METHODS FOR NONDESTRUCTIVE ASSAY OF REACTOR FUEL MATERIALS. Henry, C. N.; Menlove, H. O.; Augustson, R. H. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 4p. (CONF-681101-21). Dep. CFSTI.

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C.

Practical, on-line and in-the-field isotopic assay systems are being developed. The delayed neutron response technique of assay was applied to cold, clean MTR fuel elements. The resulting measured isotopic abundance agreed with the actual isotopic abundance to within 1%. (M.C.G.)

24102 (LA-DC-9759) DELAYED NEUTRON KINETIC RESPONSE METHODS OF ASSAY. Augustson, R. H.; Menlove, H. O.; Henry, C. N.; Masters, C. F.; Keepin, G. R. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 5p. (CONF-681101-18). Dep. CFSTI.

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C.

Delayed neutron yields and kinetics were applied to the nondestructive detection, identification, and assay of fissionable nuclides. Experimental isotope discrimination ratios at 14 MeV for ^{235}U, ^{238}U, and ^{239}Pu, ^{238}U combinations are given. The technique can determine relative abundances typically to within 3% accuracy. (M.C.G.)

24103 (NP-17816) NEW METHOD FOR THE ALPHA ACTIVITY SPECIFICATION ANALYSIS OF URANIUM FINAL PRODUCTS. Eschrich, H.; Hundere, I. (European Company for the Chemical Processing of Irradiated Fuels, Mol (Belgium)). Apr. 1968. 31p. (ETR-226). Dep.

Uranium compounds obtained as final products from processed reactor fuels should not, according to existing specifications, contain an alpha activity from transuranium elements exceeding 1,500 or 15,000 alpha disintegrations per minute per gram of uranium. An analytical method permitting the simultaneous separation of neptunium and plutonium as well as the separation of transplutonium elements from uranium in a single procedure is described. Uranium final product samples are treated to obtain a uranyl nitrate solution that is 3M in nitric acid. The neptunium and plutonium are oxidized to the hexavalent oxidation state with argentic oxide. An aliquot of the adjusted sample solution containing 200 to 400 mg uranium is introduced into an extraction chromatographic column in which purified tributyl phosphate sorbed on poly(trifluoromonochloroethylene) (Voltalef 300 Micro PL) particles forms the stationary phase. The uranium(VI), neptunium(VI), and plutonium(VI) are retained on the column while the actinides present in the trivalent state are eluted with 1.5 column volumes 3M nitric acid. On washing the column with a solution of phenylhydrazine in 3M nitric acid, neptunium is reduced to the pentavalent state and plutonium to the trivalent state and appear together in the effluent free from uranium. The elution with the phenylhydrazine solution has to be carried out within 10 minutes to reduce a possible loss of neptunium due to the formation of TBP-extractable neptunium(IV). The effluent fraction containing the neptunium and plutonium is used to determine the alpha disintegrations per minute per gram of uranium. The procedure described allows the recovery of trace amounts of neptunium and plutonium from macro amounts of uranium in a yield exceeding 85%. The recovery of americium and curium is almost 100%. The problem of the simultaneous separation of neptunium and plutonium from uranium is outlined and the application of phenylhydrazine as reducing agent by Purex type processes is briefly discussed. (auth)

24104 GAMMA-RAY SPECTROMETRY FOR AIRBORNE GEOCHEMISTRY. Adams, John A. S.; Fryer, Glenn E.; Rogers, John J. W. (Rice Univ., Houston, Tex.). Anal. Chem., 41: 22A-6; 28A(May 1969).

Gamma spectrometry offers a rapid, low cost method for airborne exploration of the earth's surface. With the exception of recently deposited sediment, young volcanic rocks, and soils it is theoretically possible to determine the concentration of Th, U, and K in terrestrial material by counting γ emission at 2.62, 1.76, and 1.46 MeV, respectively. The methods used at Rice University Laboratory and those using portable spectrometers are discussed as well as helicopter-borne surveying methods. It was concluded that the future gamma spectrometric exploration that includes multiple-channel analyzers operated in conjunction with other geophysical surveying techniques gives promise of rapid location of unusual mineralization. (D.H.M.)

24105 CHROMATOGRAPHIC ANALYSIS OF RADIOACTIVE ACID HYDROLYSATE OF HeLa CELLS LABELED WITH TRITIATED THYMIDINE. Girgis, A. Messih; Ekert, Bernard; Vieuchange, Jean (Centre National de la Recherche Scientifique, Paris. Fondation Curie, Paris. Institut Pasteur, Paris). Compt. Rend., Ser. D, 267: 2368-71(Dec. 23, 1968). (In French).

The chromatographic analysis of the acid hydrolysate of HeLa cells labeled with tritiated thymidine shows the presence of deoxyribonucleotides-^{3}H which releases thymine-^{3}H under the action of a second more prolonged hydrolysis and another part of a tritiated substance practically insensitive to the action of a prolonged powerful hydrolysis. There was no trace of tritiated products from the natural decay of thymidine ^{3}H. (tr-auth)

24106 A NEW METHOD BASED ON ALPHA PARTICLE TRACK FOR DETECTION OF RADIONUCLIDES ON ELECTROMIGRATED PAPER. Hashimoto, Tetsuo; Iwata, Shiro (Kyoto Univ.). Bunseki Kagaku, 18: 527-8(Apr. 1969). (In Japanese).

A new method for the detection of alpha radionuclides on electromigrated paper was proposed. The method is based on the alpha particle track detector with celluloid films. Alpha-irradiated films are etched in NaOH solution and are compared with the autoradiographs on x-ray films, whereby the alpha nuclides could be easily distinguished from the beta and gamma nuclides. The half life of the nuclide was confirmed from measurements of the number of alpha tracks. The method is applicable to the chemical investigation of alpha nuclides, such as actinide elements. (auth)

24107 ANALYSIS OF THORIUM X SOLUTIONS FOR LONG-LIVED RADIOACTIVE IMPURITIES. Kolb, W. PTB Mitt., 79: 19-22(Feb. 1969). (In German).

At 10 and 19 months after the proposed date of use the activity for long-lived radionuclides in a Thorium-X (^{224}Ra) solution for clinical use was estimated with a low-level scintillation spectrometer. The percentage of these contaminants was about 1.7×10^{-6}%. 2000 esu of the solution contained mainly 27 pCi ^{228}Th and 27 pCi ^{226}Ra. The values are lower by at least three orders of magnitude than the maximum permissible body burden stated by ICRP. (auth)

24108 METHOD FOR DETERMINATION OF MICROQUANTITIES OF URANIUM IN SPECIMENS WITH UNKNOWN CHEMICAL COMPOSITION. Kashukeev, N. T. Compt. Rend. Acad. Bulg. Sci., 21: 1041-4(1968). (In Russian).

A method for determining microquantities of uranium in specimens with unknown chemical composition is described. The samples were crushed to a fine powder, mixed, and divided into two identical specimens. One of the specimens was mixed with a few drops of solution containing a soluble uranium salt of known concentration and the other was mixed with a few drops of pure solvent. Then the two solutions were compressed into two tablets, which were irradiated in a neutron flux. The fission fragments from the specimens were recorded using a detector and the uranium content determined. The method is suitable for determining uranium concentrations is soil, carbon, wood, air, and water. (R.V.J.)

24109 THE LIQUID SCINTILLATION MEASUREMENT OF ^{14}C IN AQUEOUS SOLUTIONS OF FECES AND URINE. Lippert, T. H.; Ehe, L. (Univ., Heidelberg). Z. Klin. Chem. Klin. Biochem., 6: 466-7(Sept. 1968). (In German).

A method for stabilization of aqueous solutions of urine and feces for scintillation counting that used a gel system is described. The stabilizer used was Cab-O-Sil. Since the capacity of a 4% solution of this stabilizer permitted addition of a 6.5% aqueous solution, it was possible to use a mixture of 1 ml of sample and 18 ml of a dioxane scintillator with 5% Cab-O-Sil. Phosphorescence was prevented by addition of 5 drops of concentrated HCl to each sample. The measurement efficiency was 65%. The quench curves were unchanged with the stabilized solutions and the channel and gain positions were not altered. The stabilizing capacity of the Cab-O-Sil was not sufficient to maintain the counting rate constant over intervals of several days. This was particularly true for solutions with high quenching. It was possible to correct for these changes by measuring corresponding changes in count rate and quenching values over measured time intervals. (BBB)

24110 ALPHA RADIOACTIVE NUCLIDES OF URANIUM, PROTACTINIUM, AND THORIUM IN URANIUM DEPOSITS. Sakanoue, Masanobu; Komura, Kazuhisa. Geochem. J. (Nagoya), 2: No. 2, 71-86(Sept. 1968).

Uranium deposit samples were radiochemically separated into

thorium, protactinium, and uranium fractions and each fraction was submitted to alpha ray spectrometry for the determination of ^{238}U, ^{234}U, ^{231}Pa, ^{232}Th, and ^{230}Th. In an ore body of Ningyō-Tōge Mine, Okayama, Japan, the relationship between the uranium isotopes and their daughter nuclides indicates an extensive migration of uranium. The migration was also verified by the high radium and protactinium contents of a manganese nodule sample. The thorium-bearing samples in a neighboring district were also analyzed to elucidate the origin of these uranium deposits. The ages of two secondary uranium minerals in Tōno district, Gifu, were estimated to be 5×10^3 y and 34×10^3 y, on the basis of their isotopic compositions. For the radioactive phosphate samples in Noto district, Ishikawa, secondary enrichment of uranium by phosphate was confirmed with their isotopic compositions and their phosphate contents. (NSA of Japan)

Activation Procedures

Refer also to abstract 24460.

24111 (AEC-tr-7041) APPLICATION OF RADIOACTIVATION ANALYSIS TO RADIOECOLOGICAL STUDIES. Fourcy, A.; Fer, A.; Poret, C.; Neuburger, M.; Garrec, J.-P. Translated from Bull. Inform. Sci. Tech. (Paris), No. 119, 39-48(1967). 28p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 19301.

24112 (BMwF-FBK-68-58) OXYGEN DETERMINATION BY FAST NEUTRON ACTIVATION ANALYSIS. Kim, J. I.; Henkelmann, R. (Technische Hochschule, Munich (West Germany). Institut fuer Radiochemie). Dec. 1968. 17p. (In German). Dep.

For the analysis of oxygen by neutron activation the fast neutrons of a reactor neutron spectrum as well as the 14-MeV neutrons of a small accelerator can be used. The advantages and disadvantages of the two methods are discussed. A number of examples illustrating sensitivity, selectivity, reproducibility, and neutron flux monitoring are given. (auth)

24113 (CONF-670649-1) RADIOISOTOPES IN CHEMISTRY: THEIR USE WITH AND AROUND THE ARBI REACTOR. Albisu, F.; Martin, A. (Escuela Tecnica Superior de Ingenieros Industriales, Bilbao (Spain). Laboratorios de Ensayos e Investigacion Industrial). [1966]. 5p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

Two analytical techniques are widely used at the Arbi reactor, neutron activation and radiometric analyses. Neutron activation techniques are used for determination of As, Ga, Ge, In, Mn, Au, Re, and U in coal ashes, for Al, V, Mn, As, and other minor components in steel, for Al in plastics, for Re in sedimentary rocks, for trace materials in minerals, and for lanthanides in rocks. The radiometric techniques developed include the determination of U in minerals, determination of U, Th, and K in soils, and determination of K in many materials. (tr-auth)

24114 (NSJ-tr-141) DETERMINATION OF TRACE ELEMENTS IN DNASE I BY THE ACTIVATION ANALYSIS. Akaboshi, Mitsuhiko; Maeda; Toshio; Noda, Masato; Waki, Asako. Translated from Dobutsugaku Zasshi, 76: 235-8(July 1967). 7p. Dep.

Commercially available DNase I (bovine pancreatic) was activated by exposing it to a neutron flux of approximately 5×10^{12} n/cm^2/sec for 30 minutes at the pneumatic tube of the KUR (Kyoto University Reactor). Then, γ rays from ^{24}Na, ^{27}Mg, and ^{56}Mn, and β rays from ^{32}P derived from the nuclear reaction $^{32}S(n,p)^{32}P$ were detected. By counting these radioactivities, contents of these elements in DNase I were determined. The results were as follows: Na; 0.275 to 1.675 μ g/mg-DNase I, Mg; 0 to 13.25 μ g/mg-DNase I, and Mn; 0.105 to 0.150 μ g/mg-DNase I. These elements were easily removed by dialyzing DNase I against redistilled water. (auth)

24115 NEUTRON ACTIVATION ANALYSIS OF TRACES IN ELECTROLYTIC ZINC SULPHATE SOLUTION. PART IV. SIMULTANEOUS DETERMINATION OF COBALT, CADMIUM, IRON, AND INDIUM. Liessens, J. L.; Dams, R.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta, 45: 213-18(Apr. 1969).

A neutron activation analysis for the simultaneous determination of cobalt, iron, indium, and cadmium in electrolytic zinc sulfate solutions is described. The chemical separation, in hydrochloric acid medium, involved anion exchange followed by solvent extraction. Concentrations of 0.3 μg Co/ml, 25 μg Fe/ml and 0.4 μg Cd/ml were found. The concentration of indium was below the detection limit (0.01 μg/ml). (auth)

24116 NEUTRON ACTIVATION ANALYSIS OF HIGH-PURITY SELENIUM. PART IV. SIMULTANEOUS DETERMINATION OF CHLORINE, BROMINE, AND IODINE. Ballsux, B.; Dams, R.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta, 45: 337-40(Apr. 1969).

A method for determining Cl, Br, and I in Se by neutron activation analysis is presented which involves dissolution of Se in hot concentrated nitric acid from which the halogens are volatilized and then precipitated by ice-cooled silver nitrate solution. After precipitation of the silver halides, the application of high-resolution γ spectrometry allows the simultaneous determination of Cl, Br, and I. The standard deviation for Cl cannot be given owing to the low count rate; however, since radiochemically pure halide activities were separated, the detection limits can be reduced if a higher neutron flux is applied. An irradiation for 30 minutes at a neutron flux of 10^{12} n/cm^3 sec would result in detection limits of 0.05, 0.04, and 0.06 ppM for Br, I, and Cl, respectively. (D.H.M.)

24117 RAPID GROUP RADIOCHEMICAL SEPARATIONS FOR ACTIVATION ANALYSIS OF STEELS. Thompson, Barbara A.; LaFleur, Philip D. (National Bureau of Standards, Washington, D. C.). Anal. Chem., 41: 852-5(May 1969).

Rapid solvent extraction procedures for the separation of groups of elements are reported for use in the neutron activation analysis of steels. The elements for which the separation scheme was designed are W, Mo, Cu, Cr, As, and Co. α-Benzoinoxime complexes of W and Mo are extracted into $CHCl_3$, and Fe and Sb are removed by extraction of the chloride complexes into isopropyl ether. This procedure leaves Cu, As, Cr, and Co in the aqueous phase. These can readily be determined in the presence of each other, utilizing a Ge(Li) detector to separate 0.511 MeV ^{64}Cu from 0.559 MeV ^{76}As and 1.17 and 1.33 MeV peaks of ^{60}Co from 1.095 and 1.29 MeV ^{59}Fe peaks of any remaining traces of Fe. Other elements such as Au, Ga, and Sb can also be determined, if present, by examination of the ether fraction. The procedure was applied to the analysis of NBS Standard Reference Materials 6f, 101e, and 1161. The results show that precisions of ±10% at 95% confidence level can be obtained readily using these methods and that in favorable situations the precision can be ±2%. (D.H.M.)

24118 ACTIVATION ANALYSIS OF HALOGENS IN PHOTOGRAPHIC EMULSIONS USING A NEUTRON GENERATOR. Przybylowicz, E. P.; Smith, Gilbert W.; Suddueth, J. E.; Nargolwalla, S. S. (National Bureau of Standards, Washington, D. C.). Anal. Chem., 41: 819-23(May 1969).

A nondestructive neutron activation technique for the analysis of chloride and iodide in a silver bromide matrix is described. Chlorine was measured after activation with 14.7-MeV neutrons. The 3.1-MeV gamma rays from ^{37}S were measured without interference. Calibrations were carried out using photographic emulsions containing 10 to 200 mg of chlorine. The relative standard deviation of a single determination at the 10 mg level is 5%; at the 200 mg level it approaches 1%. Iodine was measured via ^{128}I produced by (n,γ) activation with 2.8-MeV neutrons. A straight line curve was established for 2 to 420 mg of iodine. The relative standard deviation of a single determination at these two levels was 20% and 1%, respectively. The method offers an attractive alternate to existing chemical and instrumental methods for the determination of iodide and chloride in silver halide mixtures because it has the potential for providing rapid analyses with reasonably good precision. (auth)

24119 DETERMINATION OF TRACE ELEMENTS BY NEUTRON-ACTIVATION ANALYSIS. Houtman, J. P. W. (Reactor Inst., Delft, Netherlands). Chem. Weekbl., 63: 450-8(1967). (In Dutch).

The theory and practice of the technique and the reactors used and their performances are described; practical conditions for the determination of 12 trace elements, and the sensitivities obtained in comparison with other methods, are tabulated. Examples are given of the determination of trace elements in white lead and human hair. (Anal. Abstr.)

24120 DETERMINATION OF ^{14}C IN STARCH AND POTASSIUM IN FELDSPAR. Wang, Jun-lan (National Tsing Hua Univ., Hsinchu, Taiwan). Ho Tsu K'o Hsueh, 6: 61-8(Oct. 1968). (In Chinese).

The determination of ^{14}C in starch and potassium in feldspar was done by a request of the International Atomic Energy Agency (IAEA) for intercomparison among its member states. The samples were provided by the Agency. The counting set-up for ^{14}C was the dating system of the National Taiwan University, while for K the nondestructive activation analysis method was used. (auth)

24121 DETERMINATION OF TANTALUM IN ROCKS BY NEUTRON ACTIVATION ANALYSIS. Vados, I.; Morai, M.; Upor, E. (Mecsek Ore Mining Enterprise, Pecs, Hungary). Acta Chim. Acad. Sci. Hung., 59: 171-80(1969).

A method has been developed for the neutron activation analysis of tantalum in rocks. On the basis of the nuclear data, the 68-keV photopeak of ^{182}Ta has been selected. In order to compare the interference by individual elements, a characteristic number has been introduced which is based on the Clark value and nuclear data, with reference to a rock sample of average composition. The separation procedure consists of fusion with alkali, followed by leaching with water. The precipitated hydroxide is then dissolved, and the tantalum extracted as thiocyanate with methyl isobutyl ketone. The loss in tantalum is very low, therefore, its determination is unnecessary. The method has been successfully applied to the analysis of tungsten ores. The time required for an analysis is 30 minutes. (auth)

24122 RADIO ACTIVATION ANALYSIS OF TRACE ARSENIC IN REFINED SOYBEAN OILS, SUNFLOWER OILS, AND RAPE SEED OILS. Shinbori, Yoshio; Kuwahara, Hideo (Musashi Inst. of Tech., Kawasaki, Japan). Yukagaku, 18: 147-8(Mar. 1969). (In Japanese).

A method was developed for quantitative determination of arsenic in refined soybean oil, sunflower oil, and rapeseed oil. The irradiation was carried out in TRIGA-II small reactor with neutron flux of 10^{11} n/cm^2/sec for 20 hours of the maximum irradiation time. After cooling, the sample was dissolved in acid by treating with nitric–sulfuric–perchloric acid in the presence of the arsenic carrier. The procedure for the distillation of arsenic is similar to that adopted by B. Sjostrand in his investigations on the recovery of arsenic from soybean oil, sunflower oil, and rapeseed oils. The mean chemical yield was a maximum of 82 percent for the arsenic, and the sensitivity of the method was 10^{-3} ppM. This method has an advantage in that it minimizes losses and contamination. (NSA of Japan)

24123 ISOTOPIC EQUILIBRIUM STUDIES OF IODINE METABOLISM WITH EMPHASIS ON THE CIRCULATING IODOTYROSINES. Rhodes, Buck Austin. Baltimore, Johns Hopkins Univ., 1968. 206p.

Thesis.

The technique of isotopic equilibrium allowed for the quantitative measurement by radioassay of iodine constituents of blood and tissues. Rats were given iodide labeled with ^{129}I, ^{125}I, or both in their drinking water. After several weeks of continual intake, the specific activity of iodine in the tissues approximated that of the ingested water, i.e., isotopic equilibrium was established. The radioactivity of tissues compared to the radioactivity of the drinking water was then a measure of tissue iodine concentration. The increased sensitivity of iodine determination was achieved by neutron activation analysis of samples from rats in ^{129}I equilibrium. With this method, a thousandfold increase in the sensitivity of iodine analysis was possible. The use of a new short-lived isotope of iodine, ^{123}I, short-term iodine uptake without interfering with the long-term ^{129}I or ^{125}I measurements. A steady-state model of iodine metabolism was developed which allowed for an estimation of the radiation dose to the rat thyroid during the course of the equilibrium studies. The radiation dosages and corresponding analytical sensitivities for ^{131}I, ^{125}I, and ^{129}I were determined. It was found that ^{125}I was superior to ^{131}I, but, when either isotope was used, analytical sensitivity was limited by the radiation to the thyroid. This limitation was eliminated by the use of ^{129}I. Neutron activation was used to induce high levels of radioactivity in the samples after they had been removed from the experimental animals. The effect of exercise on iodine metabolism was studied by measuring the uptake, storage, release and tissue distribution of iodine in exercising and nonexercising rats. Exercising rats had a decreased short-term accumulation of radioiodine and had less total iodine in their thyroids when given the same daily intake of iodine. The distribution of tissue iodine was also different; the exercising rats had higher lung to blood and muscle to blood ratios of iodine. The rate of release of iodine from thyroid stores was not found to be altered by exercise. The evidence that mono- and diiodotyrosine are normal constituents of blood was obtained by measuring the radioactivity of iodoamino acids fractions of blood from fasting fats in ^{129}I or ^{125}I equilibrium. The iodoamino acids were extracted from pooled plasma samples and separated by paper chromatography. Iodine-129 of the iodotyrosine fractions was determined by neutron activation analysis. The iodotyrosines were also detected by direct radioassay of paper chromatograms of blood extracts of ^{125}I equilibrated rats. It was concluded that movement of iodine through the blood as iodotyrosines is probably a normal pathway of iodine metabolism. (Disser. Abstr.)

24124 NON-DESTRUCTIVE DETERMINATION OF BORON IN METALLIC ALLOYS BY MEANS OF A NUCLEAR REACTION. Konecny, Klement; Vobecky, Miloslav; Juna, Jaromir (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ., 15: 128-30(Apr. 1969). (In Czech.).

A nondestructive determination of boron by means of a nuclear reaction using a lithium-drifted germanium detector is described. The applicability of the method was verified on samples of metallic alloys. (auth)

24125 DETERMINATION OF TRACES OF SULFUR BY ACTIVATION USING CHARGED PARTICLES. Debrun, J.-L.; Albert, Ph. (CNRS, Vitry-sur-Seine, France). Bull. Soc. Chim. Fr., No. 3, 1017-20(Mar. 1969). (In French).

Determination of sulfur by activation analysis is usually performed by neutron irradiation. Thermal neutrons or fast neutrons can be used. These methods do not give reliable results when traces of sulfur have to be determined in the presence of phosphorus and chlorine, since both these elements produce the same radioisotope as sulfur. The feasibility of determining trace sulfur by irradiation with charged particles was studied experimentally with protons, deuterons, and alpha particles. Protons with an energy of 11 MeV are theoretically able to determine about 10^{-2} ppM of sulfur without any interference. (auth)

24126 IRRADIATION OF SOME NATURAL ELEMENTS BY 35-MeV PHOTONS. APPLICATIONS IN ACTIVATION ANALYSIS. Debrun, J. L.; Albert, Ph. (CNRS, Vitry-sur-Seine, France). Bull. Soc. Chim. Fr., No. 3, 1020-3(Mar. 1969). (In French).

A study of the main isotopes obtained by irradiation using 35-MeV photons is presented, from 18 natural elements (fluorine, chlorine, titanium, vanadium, chromium, iron, nickel, zinc, arsenic, selenium, rubidium, strontium, zirconium, tin, iodine, gold, thallium, lead). Detection sensitivities are given for these elements in the case of 20-minute 35-MeV irradiations, with a mean nominal current of 50 μA. It is easy to determine traces of fluorine, titanium and lead. This is very difficult to do with thermal neutrons. Some interesting applications of photon activation are described, particularly the determination of nickel in copper and in cobalt. (auth)

24127 ACTIVATION ANALYSIS USING ^{4}He AND ^{3}He IONS. DETERMINATION OF TRACE OXYGEN IN HIGH PURITY IRON, NICKEL, AND CHROMIUM. STUDIES ON CARBON DETERMINATION. Debrun, J.-L.; Barrandon, J.-N.; Albert, Ph. (Centre d'Etudes de Chimie Metallurgique, Vitry-sur-Seine, France). Bull. Soc. Chim. Fr., No. 3, 1011-16(Mar. 1969). (In French).

The determination of oxygen by activation with charged particles is described. Experimental results for the concentration of oxygen in high-purity iron, nickel, and chromium are presented. ^{18}F is the radioisotope used for oxygen determination. The production of ^{18}F by nuclear reactions with elements other than oxygen is studied. The possibility of determining carbon traces after irradiation with ^{4}He and ^{3}He is studied. ^{11}C is the radioisotope used for this determination. Elements other than carbon may also produce ^{11}C and interfere. Experimental studies of beryllium and oxygen interference were performed up to 30 MeV with ^{3}He and 54 MeV with ^{4}He. (auth)

24128 THE USE OF 14 MeV NEUTRONS IN THE ACTIVATION ANALYSIS OF MINERALS. Oldham, Graham (Loughborough Univ. of Tech., Eng.); Mathur, S. C. Nucl. Energy, 58-62(Mar.-Apr. 1969).

The analysis of multi-element mixtures in minerals by 14 MeV neutron activation using γ spectroscopy and decay time control is described. Oxygen, Si, Al, Fe, and Zn may all be determined with reasonable precision. (auth)(UK)

24129 NEUTRON ACTIVATION ANALYSIS. Chem. Process. (London), 15: 28-9(May 1969).

An improved neutron activation analysis technique was developed at the U. S. National Bureau of Standards and used to determine the oxygen content in steel. The improvements increase analytical precision of neutron activation analysis tenfold; they consist of a method of evaluating systematic errors and an improved irradiation system. (auth)(UK)

24130 RAPID SIMULTANEOUS DETERMINATION OF TRACES OF BROMINE AND ARSENIC IN PLANT MATERIALS, USING NEUTRON ACTIVATION AND DISTILLATION. Fer, A.; Fourcy, A. (CEN, Grenoble, France). Nucl. Appl., 6: 360-4 (Apr. 1969).

Some medical and biochemical investigations and studies of pesticide residues in plant products require determination of elements such as bromine and arsenic in plant materials. Neutron activation analysis followed by a separation of ^{82}Br and ^{76}As using distillation, allows a sensitive and relatively rapid measurement of these two elements in plant materials as different as fruit, tobacco, or wheat flour. (auth)

24131 OXYGEN DETERMINATION IN STEEL BY NEUTRON ACTIVATION. Bihet, Oskar Louis. Stahl Eisen, 88: 1244-6 (Oct. 31, 1968). (In German).

A laboratory installation, in a steelworks, used in the routine determination of O is described. A commercial neutron generator, pneumatic equipment for handling samples, and a dual scintillation counter are used. Samples from an O-converter are cast into a tapered cylindrical mould; the surface of the casting is lathe-turned and cleaned in 2 min. (Metals Abstr.)

24132 ACTIVATION ANALYTICAL DETERMINATION OF ELEMENTS OF METEORITES. 2. DETERMINATION OF MANGANESE, SODIUM, GALLIUM, COPPER, GOLD, AND CHROMIUM IN 21 METEORITES. Schaudy, R.; Kiesl, W.; Hecht, F. (Reactor Center, Seibersdorf, Austria). Chem. Geol., 3: 307-12 (Dec. 1968).

Methods are described for estimation of Mn, Na, Ga, Cu, Au, and Cr in meteorites using neutron activation analysis. The most important steps of the analytic procedure used were: (1) irradiation of sample and standard; (2) dissolution of sample with aqua regia and HF–H_2SO_4 mixture (stony meteorites); or dissolution in HCl in presence of some H_2O_2 (iron meteorites); (3) anion exchange separation; Na, Mn, Cr and Cu are determined in the 7N HCl effluent; Cr is determined after the decay of the other activities; Ga is eluted with 0.5N HCl; Au is retained by the resin on which it is measured; and (4) measurement and evaluation using a 400-channel γ spectrometer. For the chemical separation the anion exchange Dowex 1 X8 was employed. For each analysis 70 to 110 mg of finely ground stony meteorites and 100 to 150 mg of iron meteorites were used. In the finely ground samples of stony meteorites the individual values did not deviate from a mean value by more than ±10%. (BBB)

24133 THE USE OF NEUTRON-CAPTURE GAMMA RADIATION FOR THE ANALYSIS OF BIOLOGICAL SAMPLES. Comar, D.; Crouzel, C.; Chasteland, M.; Riviere, R.; Kellershohn, C. (CEA, Orsay, France). Nucl. Appl., 6: 344-51 (Apr. 1969).

Samples of blood, bone, and hair were irradiated in vitro at the outlet of the curved neutron guide of the Saclay reactor EL3 in a flux of thermal neutrons (<0.127 eV). The capture spectra were recorded by means of a 20 cm^3 Ge(Li) detector. The elements H, B, Cl, Na, K, N, S, and P were identified. Boron, hydrogen, and chlorine were also determined in two samples of cabbage and brown seaweed. Since a homogeneous irradiation was impossible because of the weak penetration of the thermal neutrons in the biological sample, it was necessary to use an internal standard (Hg). By the capture-γ method of analysis it was also possible to measure in vivo the Ca/Cl mass ratio of a human tibia. (auth)

24134 ACTIVATION ANALYSIS WITH AN ON-LINE PDP-9 COMPUTER. Thompson, C. J. (Atomic Energy of Canada Ltd., Ottawa). Nucl. Appl., 6: 559-66 (June 1969).

A system for neutron activation analysis using an Sb : Be neutron source and an on-line PDP-9 computer is described. The irradiation of samples in a flux of 6×10^6 n/sec/cm^2 and the counting of samples with Ge(Li) detectors are controlled by the computer. The system is controlled either manually or automatically for routine analysis of many samples. The program allows the determination of the intensity and energy of gamma rays. It also displays and plots spectra and stores them on magnetic Dectape. (auth)

24135 THE DETERMINATION OF ELEMENTAL CONCENTRATIONS IN BLOOD BY NEUTRON ACTIVATION ANALYSIS. Haller, William A.; Filby, Royston H.; Rancitelli, Louis A. (Washington State Univ., Pullman). Nucl. Appl., 6: 365-70 (Apr. 1969).

By use of neutron activation analysis and a simple chemical separation procedure, fourteen elements were determined in human whole blood. Gamma analysis of the activated blood is performed with a Ge(Li) detector. The concentration range of the elements measured vary from ppB to ppT. Possible sources of error including sample contamination, fast nuclear reactions, and interfering gamma rays are considered. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 24073, 24076, 24247, 24253, 24523, and 26137–26139.

24136 (ANL-7482) A HIGH-TEMPERATURE, FLUIDIZED-BED PROCESS FOR CONVERTING URANIUM DIOXIDE TO URANIUM MONOCARBIDE. Holmes, John T.; Pavlik, John R.; Nelson, Paul A.; Graae, Johan E. A. (Argonne National Lab., Ill.). Nov. 1968. Contract W-31-109-eng-38. 16p. Dep. CFSTI.

A fluidized-bed process was studied for the conversion of UO_2 to UC. The process involves making composite particles of UO_2 and graphite and reacting them at 1450 to 1800°C in a fluidized-bed reactor using an inert gas (helium or argon) for fluidization. High reaction rates can be achieved over a wide range of process conditions. Product purity compares with that obtained in other carbothermic reaction processes. At the present state of development, bed sintering has not been completely eliminated and thus may prevent rapid removal of all of the reaction product from the fluidized-bed reactor. (auth)

24137 (ANL-7514) MASS-SPECTROMETRIC EFFUSION STUDY OF URANIUM MONOPHOSPHIDE. Reishus, J. W.; Gundersen, G. E.; Danielson, P. M.; Edwards, R. K. (Argonne National Lab., Ill.). Nov. 1968. Contract W-31-109-eng-38. 18p. Dep. CFSTI.

A mass-spectrometric effusion study of the vaporization of uranium monophosphide was completed. Between 2073 and 2423°K, the monophosphide does not vaporize congruently, but instead loses phosphorus preferentially, forming the two-phase system, U(l)–UP_{1-x}(s). The vapor species observed were U(g), P(g), and P_2(g). The temperature dependencies of the partial pressures in atmospheres are given by: $\log P_U = (5.677 \pm 0.273) - (25898 \pm 192)/T$, $\log P_P = (8.062 \pm 0.240) - (31831 \pm 340)/T$, and $\log P_{P_2} = (10.319 \pm 1.203) - (38454 \pm 1480)/T$. A value for the enthalpy of sublimation of uranium at 298°K was found to be 129.0 ± 3.7 kcal/mole from averaging our second- and third-law values, which were in good agreement with each other.

24138 (BARC-379) KINETICS OF THE REACTION BETWEEN PLUTONIUM (III) AND CHLORINE IN SULPHATE SOLUTIONS. Ghosh Mazumdar, A. S.; Gupta, B. L. (Bhabha Atomic Research Centre, Bombay (India)). 1968. 19p. Dep.

Kinetics of the oxidation of plutonium(III) to plutonium(IV) by chlorine in sulfate solutions were studied. Thermodynamic quantities of activation were calculated from the experimentally determined activation energy of the reaction. Results are discussed and a mechanism is suggested. (auth)

24139 (CEA-Bib-120) CORRELATION FACTOR AND ISOTOPE EFFECT IN SOLID-STATE DIFFUSION. Gerl, Maurice (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1968. 56p. (In French). Dep.

Consideration of diffusion mechanisms in a crystal shows that the successive jumps of a tracer atom are correlated to one another; this introduces a correlation factor f_i in the expression of the diffusion coefficient D_i of the tracer. For self-diffusion in isotopic structures, f_i is a purely geometrical characteristic of the jump mechanism; for self-diffusion in anisotropic structures and for impurity diffusion, the calculation of f_i involves different jump frequencies. Methods for analyzing self-diffusion in dilute alloys are described; in Lidiard's theory, measurements of D_i and b lead to the value of f_i; in Howard and Manning's theory, measurements of D_i, b and f_i give the jump frequencies involved in the diffusion process. Measurement of the isotope effect in diffusion is a method of determining $f_i \Delta K_i$, where ΔK_i is the fraction of the kinetic energy residing in the tracer during the jump. Le Claire's theory provides a relation between ΔK_i and the formation volume ΔV_f of a vacancy. Finally the most frequently used experimental techniques for determining f_i are given. (auth)

24140 (CEA-R-3663(2)) VOLATILITY OF RUTHENIUM DURING VITRIFICATION OPERATIONS ON FISSION PRODUCTS. PART II. FIXATION ON A STEEL TUBE. DECOMPOSITION OF THE PEROXIDE. Ortins de Bettencourt, Antonio; Jouan, Antoine (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan. 1969. 54p. (In French). Dep.

The thermal decomposition of ruthenium peroxide, RuO_4, and its deposition on steel tubing were studied. A gas current containing RuO_4 labeled with ^{106}Ru was passed through a stainless steel tube subjected to a temperature gradient that decreases in the direction of the gas flow. The temperature at which RuO_4 is deposited or is fixed on the tube is determined, and the influence of the flow rate on this deposit is studied. An attempt was made to study by a static method the kinetics of the decomposition reaction of ruthenium peroxide to give the dioxide: $RuO_4 \rightarrow RuO_2 + O_2$. Gaseous RuO_4 was introduced into a container placed in an electric oven, and the reaction followed by γ counting. (auth)

24141 (CEA-R-3732) STUDY OF THE COMPLEXES MF_6, nNaF (M = U, W, Mo). Besnard, Ginette; Dianoux, Albert-Jose; Hartmanshenn, Olivier; Marquet-Ellis, Hubert; Nguyen-Hoang-Nghi (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb. 1969. 44p. (In French). Dep.

The complexes $MF_6 \cdot nNaF$ (with M = uranium, tungsten, and molybdenum) were studied using analytical and gravimetric methods, DTA, magnetic property measurements, and infrared absorption. The results show that the octahedral MF_6 unit in these complexes

keeps its locally and partially covalent nature, but it probably has a lower type of symmetry than in the gas phase. (auth)

24142 (INP-667) DETERMINATION OF THE OXYGEN PARAMETER IN $ZnFe_2O_4$ BY NEUTRON DIFFRACTION. Balanda, M.; Szytula, A.; Dimitrijevic, Z.; Todorovic, J. (Institute of Nuclear Physics, Krakow (Poland)). Nov. 1968. 20p. Dep.

A sample of powdered $ZnFe_2O_4$ was investigated by means of neutron diffraction. From the diffraction patterns taken for angles between 11 and 67° at room and liquid nitrogen temperatures, it was concluded that zinc ferrite has a normal spinel structure ($x = 0 \pm 1\%$) with an oxygen parameter of 0.3853 ± 0.0005. (auth)

24143 (MLM-1588) RAPID ESTIMATION OF THE EQUILIBRIUM CONCENTRATION OF Pu(V) IN DISPROPORTIONATED SOLUTIONS OF Pu(IV). Silver, G. L. (Mound Lab., Miamisburg, Ohio). May 1, 1969. Contract AT-33-1-GEN-53. 5p. Dep. CFSTI.

A method of rapidly estimating the equilibrium concentration of Pu(V) in solutions of disproportionated Pu(IV) is presented, and the estimated concentration of Pu(V) in solutions of HCl is compared to observed values. (auth)

24144 (NLCO-985) SUMMARY TECHNICAL REPORT [ON REACTOR MATERIALS] FOR THE PERIOD JULY 1-SEPTEMBER 30, 1966. Burgett, R. (ed.) (National Lead Co. of Ohio, Cincinnati). Nov. 1966. Contract AT(30-1)-1156. 36p. Dep. CFSTI.

Attempts were made to reduce UO_2 with magnesium at 1600°K and 75 psia using various salt mixtures. Droplets of uranium metal were produced. A gamma monitor was designed to determine the point of deepest penetration of top impurities and voids in rolled, uncropped billets of uranium. Uranium was found to diffuse in carbide tool materials, and the cobalt binder in the carbide migrated backward from the interface. Activated alumina and thoria from the calcination of thorium hydroxide were found to be effective adsorbents of fluoride ions in aqueous thorium nitrate solutions. (auth)

24145 (RD/B/N-1272) A STUDY OF THE REACTIONS BETWEEN INDIVIDUAL OXIDES FORMED DURING THE OXIDATION OF STAINLESS STEELS. Whitlow, W. H.; Buddery, J. H. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Feb. 1969. 20p. Dep.

Stability tests were made on the individual oxides of Fe, Ni, Cr, Mn, and Si at 1000°C and in a vacuum of 10^{-5} torr. Reactions between these oxides under similar conditions were also studied. X-ray powder diffraction techniques were used to follow the course of the oxide/oxide reactions. Three types of reaction are prominent: $AO + BO \rightarrow (A,B)\ O$, $AO + B_2O_3 \rightarrow AB_2O_4$, and reactions with SiO_2. (auth) (UK)

24146 (UCRL-Trans-10334) CHANGE IN THE COMPOSITION OF URANIUM OXIDE WHEN HEATED IN AIR. Goto, Kunihiro. Translated by Ralph McElroy for Univ. of California Lawrence Radiation Lab., Livermore, from Nippon Kagaku Zasshi, 89: 927-9(1968). 8p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 6143. (auth)

24147 STRUCTURE OF THE ALKALI HYDROXIDES. IV. INTERPRETATION OF VIBRATION-ROTATION INTERACTIONS IN CsOH AND RbOH AND REFINEMENT OF STRUCTURES. Lide, David R. Jr.; Matsumura, Chi (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 50: 3080-6(Apr. 1, 1969).

A new formulation of the vibration-rotation interactions in linear triatomic molecules is developed for the purpose of explaining the anomalies found in the microwave spectra of CsOH and RbOH. This formulation, which explicitly takes into account the curvilinear nature of the motions, leads to a somewhat different partitioning of the interaction constant α_2 into harmonic and anharmonic contributions. The harmonic contribution resulting from direct averaging of the moment of inertia over the bending mode is found to dominate the α_2 constant in most linear molecules, in contrast to the traditional treatment, which leads to a large anharmonic contribution. In the alkali hydroxides the harmonic and anharmonic parts are comparable in magnitude but of opposite sign; the resulting cancellation is responsible for the unusual vibrational dependence of B_v in these molecules. The deuterium isotope shifts of B_v are in excellent agreement with the predictions of this treatment. All of the microwave and infrared data on CsOH and RbOH are consistent with a reasonable force field, although uncertainties in the harmonic force constants prevent a quantitative determination of anharmonic constants. In the absence of contrary evidence, it was concluded that the alkali hydroxides very probably have a linear equilibrium configuration. The equilibrium bond lengths in CsOH are estimated to be: $r_{CsO} = 2.391$ Å, $r_{OH} = 0.96_8$ Å; in RbOH: $r_{RbO} = 2.301$ Å, $r_{OH} = 0.95_7$ Å. (auth)

24148 POLAROGRAPHY OF URANIUM(VI) AND LEAD(II) COMPLEXES WITH L-GLUTAMINE. Lai, Tsai-teh; Chen, Monchao (Cheng Kung Univ., Taiwan). Talanta, 16: 544-50(Apr. 1969).

For uranium(VI), the complexes UO_2G^{+2}, $UO_2G_2^{+2}$ and $UO_2(OH)G_2^{+}$ were identified at pH < 2.5, pH 2.5 to 4.1 and pH 4.1 to 5.2 respectively where G = L-glutamine. With lead(II), complexes, PbG^{+2}, $Pb(OH)G^{+}$, and $Pb(OH)G_2^{+}$ were formed at pH 2.0 to 5.0, pH 5.0 to 7.0, and pH 7.0 to 8.5, respectively. The concentration dissociation constant of $Pb(OH)G_2^{+}$ was found to be $pK_c = 10.16 \pm 0.04$ at ionic strength 0.6. (auth) (UK)

24149 RAMAN SPECTRA OF HYDROGEN AND DEUTERIUM HALIDE CRYSTALS. Ito, Mitsuo; Suzuki, Masako; Yokoyama, Tohru (Tokyo Univ.). J. Chem. Phys., 50: 2949-60(Apr. 1, 1969).

The crystal Raman spectra of HCl, DCl, HBr, and DBr have been observed for the lattice and intramolecular vibrational regions. The results for the intramolecular region indicate that the crystal structure of the low-temperature orthorhombic phase is $C_{2v}^9 - P_{n2_1a}$ with four molecules in a unit cell, containing nonplanar hydrogen-bonded zigzag chains. However, the nonplanarity of the chain is so small that it is not sensitively reflected to the spectra of lattice vibrational region. As a result, the lattice vibrational bands may be assigned adequately based on a planar structure $C_{2h}^{12} - B_{b2_1m}$, which is the structure determined by neutron diffraction measurement. Normal coordinate calculations have been made by using several kinds of intermolecular potentials. A central force field which assumed dispersion and repulsion forces and dipole-dipole forces failed to explain the observed lattice frequencies. A potential which assumed hydrogen bonding explicitly gave a reasonable fit of the calculated frequencies with the observed ones. The calculations showed that the hydrogen bond involved is relatively weak and high frequencies of the rotational lattice vibrations in spite of the weakness of the hydrogen bond are due simply to a small value of the moment of inertia of the molecule. The Raman spectra of the high-temperature cubic phase showed no strong band in the lattice region and very broad bands in the stretching region. From the results obtained, a model for the molecular reorientational motions in the cubic crystals has been proposed, in which the molecule in the crystal is bound to one of the equilibrium orientational positions, but reorients at random from one equilibrium position to the other before the molecule as a whole completes one cycle of translational oscillation. This model seems to explain the experimental data available. (auth)

24150 HYDROGEN ABSTRACTION FROM AMIDES. ISOTOPE EFFECTS, REACTIVITY OF DIFFERENT SITES, AND SECONDARY EFFECTS IN THE REACTION OF METHYL RADICALS WITH FORMAMIDE AND ACETAMIDE. Gray, P.; Leyshon, L. J. (Univ. of Leeds, Eng.). Trans. Faraday Soc., 65: 780-91(Mar. 1969).

The gas-phase attack by methyl radicals on acetamide, acetamide-d_3, formamide, and formamide-N-d_2 was studied, and hydrogen and deuterium abstraction rates were measured. Methyl and methyl-d_3 radicals were produced by photolysis of acetone and acetone-d_6. Measurements on acetamide were made in the temperature range 122 to 259°C; the maximum temperature regularly employed with the formamides was 202°C. Rate constants for the reactions were derived, and Arrhenius parameters are given. Throughout the temperature range studied the rates of abstraction of hydrogen from the different sites in acetamide were approximately equal; e.g., at 150°C abstraction from the nitrogen atom accounted for 52% of the attack. The individual reactivities are compared with those of methyl and amino groups in other molecular environments, and the reactivities of the methyl and methyl-d_3 groups in acetamide and acetamide-d_3 are discussed in terms of theories of kinetic isotope effects. Comparison of the work with published data for methyl radical attack on N-dimethyl acetamide enables the reactivity of the N-methyl groups in that compound to be assessed. In formamide reliable data could be obtained for abstraction of hydrogen from the formyl position. The reactivity of the formyl hydrogen was similar to that in related compounds HCOX where X is H, CH_3, or OCH_3. There was evidence for the existence of secondary attack by a disproportionation reaction that has no parallel in acetamide, viz., $CH_3 + HCONH_2 \rightarrow CH_4 + {}^{\cdot}CONH_2$; $CH_3 + {}^{\cdot}CONH_2 \rightarrow CH_4 + HNCO$. The complementary route to HNCO: $CH_3 + HCONH_2 \rightarrow CH_4 + HCONH^{\cdot}$; $CH_3 + HCONH^{\cdot} \rightarrow CH_4 + HNCO$, is unimportant. The secondary reaction prevents a direct estimate of the primary reactivity of the amide group in formamide. (auth) (UK)

24151 RATES OF WATER-CATALYSED REACTIONS IN WATER-DEUTERIUM OXIDE MIXTURES. Batts, B. D.; Gold, V. (King's Coll., London). J. Chem. Soc., A, No. 6, 984-7(1969).

La Mer and Greenspan's measurements (Trans. Faraday Soc., 33: 1266(1937)) on the rate of the water-catalysed decomposition of nitramide and new results on the hydrolysis of acetic anhydride in H_2O-D_2O mixtures are analyzed in terms of the theory of H_2O-D_2O systems. The results are shown to bear a qualitative resemblance to the thermodynamic isotope effect on the ionic product of water in H_2O-D_2O mixtures. They can be quantitatively accounted for in terms of transition-state models, consistent with the conclusions of other mechanistic studies, in which there is an incipient charge separation similar to the complete charge-separation in ionized water. (auth) (UK)

24152 PRECIPITATION AND COMPLEX SOLUBILITY OF URANIUM(VI) IN LITHIUM HYDROXIDE SOLUTIONS. Tomazic, B.; Zutic, V.; Branica, M. (Inst. Rudjer Boskovic, Zagreb). Inorg. Nucl. Chem. Lett., 5: 271-5(Apr. 1969).

The precipitation, spectrophotometric, and polarographic data presented indicate the formation of soluble and stable uranyl hydroxo complexes in lithium hydroxide solutions. Investigation of the character of the complex form of uranium(VI) in highly alkaline solutions is in progress. (UK)

24153 STABILITY CONSTANTS AND COORDINATION NUMBERS FOR THE CHELATES OF TERVALENT TRANSPLUTONIUM ELEMENTS WITH IMINODIACETIC DERIVATIVES. Eberle, S. H.; Bayat, I. (Univ. of Karlsruhe, Ger. Institut fuer Radiochemie, Karlsruhe, Ger.). Inorg. Nucl. Chem. Lett., 5: 229-34 (Apr. 1969). (In German).

Cation exchange measurements were used to determine the stability constants of chelates of trivalent americium and curium with three iminodiacetic derivatives, the results being compared with measurements on trivalent cerium compounds studied previously. A relation between the coordination number and the stability constant is derived from these and earlier results on chelation of trivalent transplutonium elements with aminopolycarboxylic acids. (UK)

24154 NUCLEAR MAGNETIC RESONANCE SHIFTS OF PARAMAGNETIC ORGANOMETALLIC ACTINIDE COMPLEXES. II. URANIUM(IV)–TRISCYCLOPENTADIENYL BOROHYDRIDE. von Ammon, R. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.); Kanellakopulos, B.; Fischer, R. D.; Laubereau, P. Inorg. Nucl. Chem. Lett., 5: 219-24(Apr. 1969).

Consideration was given to the PMR spectra of the complexes of U and Th with triscyclopentadienyl borohydride. Due to the presence of the BH_4 ligand the Cp_3MBH_4 compounds were expected to show signals specific for Cp ring protons and for BH_4 protons, respectively. For further comparison with Cp_3UBH_4 the diamagnetic Zr compound $Cp_2Zr(BH_4)_2$ was also studied. All three compounds were sufficiently soluble in tertrahydrofuran, and even in deuterobenzene, to give well-resolved spectra. Results are tabulated for PMR shifts of these complexes, and discussed for Cp protons and BH_4 protons. (UK)

24155 QUENCHING OF THE FLUORESCENCE OF THE CEROUS ION IN AQUEOUS SOLUTION BY SOME ORGANIC LIGANDS. Boden, H. (Arvida, Port Quebec, Can.). Nature (London), 222: 161-2(Apr. 12, 1969).

Investigations were made using 10^{-5} to 10^{-3}M solutions of cerous chloride. Quenching depended on the ligand concentration and pH of the solution, and the following order was found: (cyclohexylenedinitrilo) tetraacetic acid (Cy DTA) > EDTA > citrate > tartrate > acetylacetone > glycolate > lactate > acetate > triethanolamine. This appeared to be the same order as ability to complex Ce, and an attempt was made to estimate stability constants from the data, assuming that any complexes formed were non-fluorescent. Free cerous ion concentrations were measured from the residual fluorescence as a function of pH on the presence of various ligand concentrations. Results are shown in tabular form and confirm that coordination of the first organic ligand to the cerous ion is sufficient to quench fluorescence completely. An explanation for this is given. (UK)

24156 THERMODYNAMIC ISOTOPE EFFECTS OF HYDRIDES. Knyazev, D. A.; Bantysh, A. N.; Ivlev, A. A. (Chemical-Technological Inst., Moscow). Kernenergie, 12: 9-18(Jan. 1969). (In German).

The ratio of the partition functions (β-factors) of the isotopic species of hydrides is calculated by the method of statistical thermodynamics. The hydrides of the IV-th group yield maximum values of the β-factors. In each group β_Y and β_H decrease monotonously as the order number of the elements forming the hydrides increases. The β-factors are correlated with intramolecular parameters, and their dependence on the electron density is studied. The correlations obtained are used to calculate molecular data of compounds for which spectroscopic data are not available. (auth)

24157 RATE OF ISOTOPE EXCHANGE IN ENZYME-CATALYZED REACTIONS. Yagil, Gad; Hoberman, Henry D. (Albert Einstein Coll. of Medicine, Bronx, N. Y. Weizmann Inst. of Science, Rehovoth, Israel). Biochemistry, 8: 352-60(Jan. 1969).

The methodology of treating the kinetics of isotope exchange catalyzed by enzymes is discussed. A relatively simple way of deriving the equations relating velocity at equilibrium of an enzymatic reaction with the kinetic parameters of the reaction is described. The following general relations are helpful. The equilibrium rate of n consecutive reactions is given by $1/V_e = \sum_1^n 1/V_i$. The equilibrium rate of n parallel reactions is $V_e = \sum_1^n V_i$. (auth)

24158 A STUDY OF THE HYDROGEN EXCHANGE OF α, α, α'-TRIMETHYLGLUTARIC AND n-BUTYRIC ACIDS. Brink, C. v. d. M.; Bok, L. D. C.; van Rensburg, D. J. J. (Univ. of the O. F. S., Bloemfontein, S. Afr.). Z. Phys. Chem. (Frankfurt), 62: 145-51(Oct. 1968).

The rate of exchange of the α-hydrogen atoms of α, α, α'-trimethylglutaric acid and of n-butyric acid with the solvent water, was investigated at various temperatures, both in the forward and in the reverse directions. (auth)

24159 FIXATIONS OF URANYL ION SULFURIC ACID AND SULFURIC–NITRIC ACID SOLUTIONS ON ANION EXCHANGERS. Kikindai, Marthe (Ecole Centrale des Arts et Manufactures, Paris). Compt. Rend., Ser. C, 268: 1057-60(Mar. 17, 1969). (In French).

The influence of the presence of nitric acid on the fixation of uranyl ion from sulfuric acid solutions on an anion exchanger was studied, and it was shown that in the process of fixation on a column there exists a ratio $(SO_4)/(NO_3)$ for a given uranyl solution beginning with which there is observed a maximum retention as a function of the volume of the solution that passes. (tr-auth)

24160 INFLUENCE OF THE HETEROPHASE ADDITIONS OF SOME OXIDES ON THE KINETICS OF THE REDUCTION OF U_4O_9 WITH HYDROGEN. Vlasov, V. G.; Pis'menko, V. T.; Larin, A. A. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met., No. 1, 83-6(1969). (In Russian).

The effect of the heterophase addition of CaO, SrO, Y_2O_3, and ThO_2 on the kinetics of the reduction of the β-dioxide of U with H_2 was studied. Additions of these oxides accelerated the reduction process. Variation of the rate and quantity of the addition CaO–SrO occurs asymmetrically: 3 and 1 mole % of the addition accelerates the process to a greater extent than 10 mole %. With increases in the quantity of the additions Y_2O_3 and ThO_2 the rate of the process increases regularly. The results obtained were interpreted by means of contact phenomena, screening the effect of the addition and the possibility of partial diffusion into the crystal lattice of the oxide being reduced. (tr-auth)

24161 DEUTERIUM ISOTOPIC EFFECTS IN THE FORMOLYSIS OF BENZYL FLUORIDE. Beguin, Claude (Faculte des Sciences, Grenoble, France). Bull. Soc. Chim. Fr., No. 2, 372-8(Feb. 1969). (In French).

The formolysis of optically active benzyl α-1-d-fluoride goes with racemization. The value of the α deuterium kinetic effect is shown to be 1.15, the value for a reaction with a carbonium-like transition state. The kinetic solvent effect (HCOOH and HCOOD) is a normal one ($k_H/k_D > 1$). This is interpreted on the basis of a fast preequilibrium leading to the conjugated acid of the substrate, and by the structure $H-C^{OH}_{OH}{}^{+}$ of the conjugated acid of formic acid. (auth)

24162 EFFECT OF METALS ON HYDROGEN–TRITIUM EXCHANGE OF PROTEINS. Emery, Thomas F. (Yale Univ., New Haven). Biochemistry, 8: 877-82(Mar. 1969).

The effects of metals on hydrogen–tritium exchange in several proteins were examined. The rate of exchange in conalbumin (ovotransferrin) is decreased by the chelation of iron or copper. Examination of the exchange as a function of iron concentration shows that only the two metal ions specifically bound to the protein are effective in retarding hydrogen exchange. The hydrogens affected are of a slowly exchanging type with an average half-life of 1.5 to 2 hr in the absence of metal. The data suggest that the effect of metal bindings on exchange is complex and that while hydrogens in some regions of the protein are protected from exchange there are other regions of the protein that may become exposed to exchange. Binding of iron or copper caused no significant change in the optical rotatory dispersion of conalbumin between 300 and 200 mμ. The exchange in lysozyme, serum albumin, and hemoglobin was not affected by the presence of iron, nor was ribonuclease affected by copper under conditions where copper is

bound to the protein. Chelation of zinc by apocarbonic anhydrase caused a slight increase in the number of rapidly exchanging hydrogens. Binding of the inhibitor, acetazolamide, to carbonic anhydrase did not affect exchange. (auth)

24163 HYDROGEN–DEUTERIUM EXCHANGE OF TRYPSIN AND TRYPSIN DERIVATIVES. Lenz, David E.; Bryan, William P. (Boston Univ.). Biochemistry, 8: 1123-32(Mar. 1969).

Hydrogen–deuterium exchange in trypsin and two trypsin derivatives, diisopropylphosphoryl-trypsin and N-tosyl-L-lysine chloromethyl ketone-trypsin, was studied by means of infrared spectroscopy. Measurements were made at 23° (0.1 M KCl in D_2O) and at pD values from 2 to 8. Four different classes of exchanging hydrogens were found: a fast class with a pD-dependent rate constant for exchange, a medium class with an essentially pD-independent rate constant for exchange, a slow class with a pD-independent rate constant for exchange, and a "core" class which does not exchange within 24 hr. The fast class could only be observed at pD values around 2 and probably consists of completely exposed peptide hydrogens. The medium and slow classes appear to exchange by a mechanism in which the rate is determined by transconformational exposure of unexposed peptide groups. The rate constants for exchange of the medium or slow classes are essentially the same for trypsin, diisopropylphosphoryl-trypsin, and N-tosyl-L-lysine chloromethyl ketone-trypsin. The numbers of hydrogens per class are essentially the same for the medium, slow or "core" classes for all three substances. These results imply that the medium slow, or "core" peptide hydrogens are essentially structurally identical. (auth)

24164 CHEMISTRY OF PROMETHIUM. VII. THE VAPOR-PHASE HYDROLYSIS OF PROMETHIUM(III) CHLORIDES. HEAT EFFECT AND GIBBS ENERGY OF THE REACTION $PmCl_3(s) + H_2O(g) \rightleftharpoons PmOCl(s) + 2\ HCl(g)$. Weigel, F.; Wishnevsky, V.; Scherer, V.; van Ghemen, M. (Univ., Munich). Radiochim. Acta, 11: 38-43(Mar. 1969). (In German).

By means of the method of Cunningham, Koch, and Broido, which has been adapted to work with highly radioactive materials, the equilibrium constant of the reaction: $PmCl_3(s) + H_2O(g) \rightleftharpoons PmOCl(s) + 2\ HCl(g)$ was measured in the temperature range 732 to 872°K. Using the equations derived by Koch for ΔC_p, ΔG_T^0, and ΔH_T^0, the thermodynamic parameters of the above reaction were determined, and the following numerical values were obtained: $\Delta G_{298}^0 = 10.4$ kcal/Mole, $\Delta G_{785}^0 = -4.9$ kcal/Mole, $\Delta H_{298} = 20.3$ kcal/Mole, $\Delta H_{785} = 18.9$ kcal/Mole, $\Delta S_{298} = 33.2$ eu, $\Delta S_{785} = 30.3$ eu. Using the interpolated value for the heat of formation of $PmCl_3$: $\Delta H_{298}^0(PmCl_3) = -252 \pm 2$ kcal/Mole, the heat of formation of PmOCl was calculated to be ΔH_{298}^0 (PmOCl) $= -245.3$ kcal/Mole. The synthesis of promethium oxychloride by means of vapor phase hydrolysis of $PmCl_3$ is described. (auth)

24165 I-[(5-BROMO-2-PYRIDYL)AZO]-2-NAPHTHOL AS A POSSIBLE NEW CHROMOGENIC REAGENT. Shibata, Shozo; Goto, Kazuo; Kamata, Eijiro (Government Industrial Research Inst., Nagoya, Japan). Anal. Chim. Acta, 45: 279-88(Apr. 1969).

The heterocyclic azo compound, I-[(5-bromo-2-pyridyl)azo]-2-naphthol (5-Br-β-PAN), forms various colored metal chelates, which can be extracted with different organic solvents. Most of the reacting metals form reddish chelates, except for cobalt(III) and palladium(II) (green), and vanadium(V) (olive). Chelate stability is greatly affected by pH. The molar absorptivities are usually considerably greater than those of the β-PAN chelates. A correct choice of pH, solvent and masking reagents allows 5-Br-β-PAN to be made reasonably selective. (auth)

24166 THE INFRARED ABSORPTION SPECTRA OF CARBAMIDE-CONTAINING TETRAHALIDE AND NITRATE COMPLEX COMPOUNDS OF THORIUM. Petrov, K. I.; Molodkin, A. K.; Ivanova, O. M.; Saralidze, O. D. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim., 14: 419-28(Feb. 1969). (In Russian).

Studies were made on the ir absorption spectra of thorium nitrate and halide complexes with urea. With the composition $ThL_4 \cdot m(NH_2)_2CO \cdot nH_2O$ (L = NO_3^-; m = 7, n = 2.5; m = 10, n = 0; m = 11, n = 2.5; L = Cl^-, Br^-, I^-, m = 8, n = 0; L = NO_3^-, Br^-, I^-, m = 6, n = 2; L = NO_3^-, Cl^-, Br^-, m = 4, n = 4; L = Cl^-, m = 5, n = 6; L = Br^-, I^-, m = 2, n = 6; L = NO_3^-, m = 2, n = 1, respectively, and also $MgTh(NO_3)_6 \cdot 6(NH_2)_2CO \cdot 4H_2O$ and $NiTh(NO_3)_6 \cdot 5(NH_2)_2CO \cdot 3H_2O$. It was established that in all cases coordination of urea by thorium is achieved with oxygen. In urea-containing tetrahalide complexes, thorium coordinated up to 8 and in tetranitrates up to 11 urea molecules. It was found that in tetranitrate complexes with the ratio $(NH_2)_2CO$:Th = 4 and above the nitrate group is displaced in the internal coordination thorium sphere into the external sphere. (tr-auth)

24167 DETERMINATION OF THE RATE CONSTANT FOR THE REACTION OF ATOMIC DEUTERIUM WITH TERMINAL ALCOHOLS BY THE METHOD OF THE LIMITS OF SELF-COMBUSTION. Dzotsenidze, Z. G.; Oganesyan, K. T.; Nalbandyan, A. B. (Tbilisi State Univ., USSR). Arm. Khim. Zh., 21: 370-4 (1968). (In Russian).

The mechanism of combustion of molecular D_2 was studied to determine the rate constant of the reaction of the D atom with different compounds acting as inhibitors of the process. The method of the lower limit of spontaneous combustion was used beginning with a mixture of $3D_2 + O_2$. Kinetic analysis of these data was applied then to similar mixtures with added ROH, for temperatures between 570 and 670°C. Rate constants are given by 0.027×10^{-10} exp (−8600/RT)cm^3/sec for CH_3OH, 0.075×10^{-10} exp (−6900/RT) cm^3/sec for C_2H_5OH, 0.072×10^{-10} exp (−5600/RT) cm^3/sec for n−C_3H_7OH, and 0.087×10^{-10} exp (−4900/RT) cm^3/sec for n−C_4H_9OH. Mechanistic implications of these results for the attack of H atoms on alkane chains and alcohols are discussed. (BBB)

24168 THE COMPOSITION OF THE URANIUM(VI AND IV)–ARSENAZO III COMPLEXES. Onishi, Hiroshi; Sekine, Keiichi (Japan Atomic Energy Research Inst., Tokai). Bunseki Kagaku, 18: 524-6(Apr. 1969). (In Japanese).

Previous investigations have shown that uranium-(IV) can be determined very sensitively with Arsenazo III in 6 to 7M hydrochloric acid solutions and that uranium(VI) can be determined sensitively with the same reagent at pH 2. A study was made to establish the empirical formula of the uranium (VI and IV) – Arsenazo III complexes under analytically useful conditions. Results of the continuous variation(s) method and the polarographic method indicate that at pH 1.1 to 3.4 the complex is formed by one mole of uranium(VI) reacting with one mole of Arsenazo III. A result of the continuous variation(s) method indicates that in about 6M hydrochloric acid solution the complex is formed by one mole of uranium(IV) reacting with two moles of Arsenazo III. (auth)

24169 THE ADSORPTION OF URANIUM HEXAFLUORIDE. II. TRANSPORT PROCESSES IN THE SORPTION OF URANIUM HEXAFLUORIDE. Mueller, I.; Fay, L. (Mecsek Ore Mining Enterprise, Pecs, Hungary. Univ. of Chemical Industries, Veszprem, Hungary). Acta Chim. Acad. Sci. Hung., 59: 181-200 (1969).

Various diffusion-adsorptions were treated on the basis of the Damköhler's equation. In this concept, adsorption (boiling) is represented by static adsorption kinetics. First, the description of measuring equipment, developed for the investigation of UF_6 adsorber systems is presented, and the results are given. The data obtained show that kinetic equations which involve the condition of a linear isotherm, are unsuitable for the interpretation of the kinetics of interaction between UF_6 and the adsorbent. Therefore, new kinetic equations, under the assumption of a Freundlich-type isotherm have been derived. The resulting performance function was used for the description of the kinetic curve. (auth)

24170 DESORPTION OF BARIUM FROM GRAPHITE. Iwamoto, Kazumi (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 6: 222-4(Apr. 1969).

Since vaporization from graphite surfaces plays an important role in the transport of fission products from graphite, experiments were performed to measure the rate of description of Ba from graphite. The concentration of Ba on the graphite during the heatings was measured by counting the γ activity of ^{133}Ba. Results show that desorption occurred at 965°C when the initial Ba concentration was 10 mg/g of graphite, but when it was below about 3 mg/g it was necessary to raise the temperature above 1,000°C for any change of Ba concentration to be detectable. The activation energies varied from 53 to 90 kcal/ml and increased with Ba concentration below 3 mg/g. It was concluded that the increase in activation energy from desorption below about 3 mg/g could be attributed to the heterogeneity of the graphite surface. (D.H.M.)

24171 A KINETIC INVESTIGATION OF LANTHANIDE(III) COMPLEXATION. II. DEUTERIUM ISOTOPE EFFECTS AND ACTIVATION PARAMETERS FOR THE LANTHANIDE(III)–ANTHRANILATE REACTION. Silber, Herbert B.; Farina, Robert D.; Swinehart, James H. (Univ. of California, Davis). Inorg. Chem., 8: 819-24(Apr. 1969).

Deuterium isotope effects and activation parameters were measured for the rate constants k_{12} and k_{32} in the reaction $Ln^{3+} + An^- \underset{k_{32}}{\overset{k_{12}}{\rightleftharpoons}} LnAn^{2+}$ where Ln^{3+} and An^- represent the 3+ lanthanide and the anthranilate (o-aminobenzoate) ions. The kinetics of several other selected lanthanide–ligand systems were partially examined. Possible interpretations of the results in terms of the

solvation of the 3+ lanthanide are discussed. The kinetic experiments were carried out using temperature-jump relaxation techniques. (auth)

24172 THE HEAT OF MIXING OF THE SYSTEMS ORTHO H_2–PARA H_2 AND ORTHO D_2–PARA D_2 IN THE LIQUID STATE. Bakx, I. N.; Knaap, H. F. P. (Kamerlingh Onnes Laboratorium, Leiden). Physica, 39: 1-4(July 1, 1968).

The heats of mixing of the ortho and para modifications of both H_2 and D_2 have been measured in the liquid state at 20°K. Both systems cool upon mixing. The heat of mixing for 50 percent mixtures was found to be 2.2 ± 0.15 J/mole for H_2 and 2.3 ± 0.15 J/mole for D_2. Qualitative agreement was found with theoretical predictions. (auth)

24173 POTASSIUM EXCHANGE KINETICS IN AMPHIBIAN ATRIAL MYOCARDIUM. Loh, Chun Kyu. Minneapolis, Univ. of Minnesota, 1968. 169p.

Thesis.

Uptake and washout of ^{42}K were studied in single isolated amphibian atrial trabeculae under a steady state condition of cell K. The perfusion chamber was mounted between two gas-flow radiation detectors permitting continuous recording of tissue activity. The preparation could be driven electrically. Resting and developed tension were also recorded continuously. When isotope loading was of sufficient duration (6 hr or more), isotope exchange approached equilibrium (99%), and uptake and washout curves were symmetrical. Graphic analysis of the curves yielded a minimum of three exponential terms, corresponding to three parallel compartments of cell K with mean turnover half times of approximately 12, 29, and 180 min, and mean relative sizes of 59, 36, and 5%, respectively. Evidence was obtained which appeared to support a model system in which at least compartments 1 and 2 were arranged in a series. Therefore, as a preliminary attempt, the means of various parameters of a parallel model system were subjected to a three-compartment series open model system, and the results are as follows: $k_{10} = 5.33 \times 10^{-3}$ minute^{-1}, $k_{21} = 2.8 \times 10^{-2}$ minute^{-1}, $k_{12} = 4.0 \times 10^{-3}$ minute^{-1} (subscript 0 refers to extracellular compartment); the sizes of compartments 1 and 2, 87.5 and 12.5%, respectively. K exchange rates in the resting preparation (measured only for the first two compartments) were significantly reduced by stimulating 30 beats/min. It appears that permeability of cell membrane to K decreases upon stimulation. Since at isotope exchange equilibrium total tissue activity (corrected for extracellular K) provides a measure of total cell K, the method permits continuous monitoring of this parameter. This capability was used to reexamine the relationship between cell K loss and the inotropic response to a digitalis glycoside, Cedilanid-D. While a positive inotropic response to the drug was observed over a range of external K concentrations, (2.0 to 4.2 mM), at the higher concentrations, the inotropic response was not accompanied by a loss of cell K. Thus, net loss of cell K does not appear to be an essential part of the inotropic response to digitalis. Spontaneous oscillations in the level of isometric tension generated by the isolated amphibian atrial trabecula were observed. These could not be related with K movements. (Disser. Abstr.)

24174 PREPARATION OF THIN TARGETS FOR 3 MeV VAN de GRAAFF ACCELERATOR STUDIES. Lin, E. K.; Kiang, G. C.; Tzeng, H. S. (National Tsing Hua Univ., Taiwan, China. Academia Sinica, Taiwan, China). Chin. J. Phys. (Taiwan), 6: 67-73(Oct. 1968).

A method is described for the preparation of thin targets by means of a vacuum evaporation technique for use in the experimental studies of nuclear reaction at low energies. With this method, five thin targets of about 20 $\mu g/cm^2$ can be obtained in a single evaporation. The preparation of a magnesium target is presented as an example, and the determination of the thickness of the thin target is given. (auth)

24175 INTERACTION OF URANYL IONS WITH PHOSPHOLIPID AND CHOLESTEROL MONOLAYERS. Shah, Dinesh O. (Lamont Geological Observatory, Palisades, N. Y.). J. Colloid Interface Sci., 29: 210-15(Feb. 1969).

Uranyl acetate is widely used as a stain in electron microscopy to preserve and to reveal the structure of biomembranes. Since phospholipids and cholesterol are major lipids in biomembranes, the interaction of uranyl acetate with monolayers of these compounds was studied. Surface potential measurements indicated that uranyl ions interact with phosphate groups in lecithin monolayers but not in phosphatidic acid monolayers. Steric factors and ionic charges may be involved in the interaction between phosphate groups and uranyl ions. The interaction of uranyl ions with the phosphate groups tends to solidify lecithin monolayers and to increase the surface potential. (BBB)

24176 ABSORPTION SPECTRA IN THE VACUUM ULTRAVIOLET AND THE IONIZATION POTENTIALS OF NAPHTHALENE AND NAPHTHALENE-d_8 MOLECULES. Angus, J. G.; Christ, B. J.; Morris, G. C. (Univ. of Queensland, St. Lucia, Australia). Aust. J. Chem., 21: 2153-9(Sept. 1968).

The vapor absorption spectra of naphthalene and naphthalene-d_8 were obtained photographically and photoelectrically from 50000 to 70000 cm^{-1}. A series of Rydberg transitions and possibly two $\pi^* - \pi$ systems are observed. Each of the five Rydberg series converges to an ionization potential of 65620 ± 40 cm^{-1}, i.e., 8.13$_6$ ± 0.005 eV ($C_{10}H_8$), and 65640 ± 60 cm^{-1}, i.e., 8.13 ± 0.008 eV ($C_{10}D_8$). The quantum defects of the series are (0.94, 0.88, 0.67, 0.53) ± 0.01. The spectrum of naphthalene-d_8 was very similar to that of naphthalene. Five series were identified with the same quantum defects and similar relative intensities as those observed in naphthalene. Early members of the Rydberg series were shifted by ~20 cm^{-1} to the blue. The errors involved are slightly higher than in naphthalene because the bands were not as well defined, possibly because of the presence of isotopic impurities. Experimental results are compared with theoretical, and good agreement exists between the spectroscopic value and that obtained by photoionization. The electron impact value is slightly higher. (BBB)

24177 MECHANISTIC STUDIES ON THE PHENONIUM ION AND KINETIC ISOTOPE EFFECTS IN 2-PHENYLETHYL TOSYLATE ELIMINATIONS. McFarlane, Finley Eugene. Chapel Hill, N. C., Univ. of North Carolina, 1968. 80p.

Thesis.

Attempts were made to trap the phenonium ion in the solvolysis of substituted 2-phenylethyl tosylates in aqueous diglyme and in absolute alcohol with sodium borohydride. No products attributable to successful trapping of the phenonium ion were detected. The nature of the para-nitrophenonium ion was examined by the deamination of ^{14}C-labeled 4-nitro-2-phenylethylamine in glacial acetic acid with sodium nitrate. The isolation and degradation of the hydride migration product, 4-nitro-1-phenylethylacetate, revealed that only 0.16% of the ^{14}C had undergone rearrangement. The 2-phenylethylacetate product underwent ^{14}C rearrangement to the extent of 4.87%. The lack of a significant amount of ^{14}C rearrangement in the 1-phenylethylacetate is taken as evidence that the bridged phenonium ion does not re-open to its classical counterpart. The phenonium ion is believed, therefore, to be an intermediate and not a transition state between equilibrating classical cations. The acetolysis of ^{14}C-labeled 2-phenylethyl tosylate is studied in the absence of acetate buffer at 90 and 115°C. The percent of ^{14}C rearrangement in the product was determined at each temperature. The rate of ^{14}C rearrangement in the tosylate reactant was also determined. The data led to the conclusion that 2-phenylethyl tosylate undergoes acetolysis by a dual mechanism. The thermodynamic parameters associated with each reaction path were calculated and were found to be in agreement with those previously proposed for the two mechanistic paths. The elimination reactions of substituted 2-phenylethyl tosylate-2-d compounds were studied in dimethylsulfoxide at 90°C using phenoxide bases. The kinetic isotope effects obtained were in the range of 2.3 to 2.8. These low values are interpreted as indicating an E2 leaning toward E1 type of transition state. This type of transition state is characterized by extensive carbon-oxygen bond stretching but small on carbon-hydrogen bond stretching. (Disser. Abstr.)

24178 ACID CLEAVAGE OF ISOBUTENYLMERCURIC BROMIDE. Landholm, Richard A. Minneapolis, Univ. of Minnesota, 1968. 139p.

Thesis.

Isotope effects, general acid catalysis, and relative reactivities show that proton transfer to one of the unsaturated C atoms is rate determining for the acidolysis of unsaturated alkylmercuric halides. For compounds, $R_1R_2C-CHHgX$, exchange of iodide for bromide produces an acceleration of a factor of ~5, while substitution of CH_3 for H at R_1 or R_2 leads to an acceleration of a factor of ~30. The relatively small effect of substitution of CH_3 for H at the β carbon and the relative facility of the reaction (when compared to isobutene hydration) suggests an olefin-mercuric halide complex as the product of the rate determining step, rather than a single carbonium ion. The catalytic effect of excess Br^- on the acidolysis of isobutenylmercuric bromide is consistent with the proposed intermediate. The Brønsted catalysis law is obeyed with a variety of carboxylic acids, giving an α of 0.69 ± 0.04. The acetic acid catalytic coefficient is larger by a factor of 200 than that predicted if it were due to specific hydronium ion-general base catalysis instead of true general acid catalysis. Acids of other structures or charge types (H_3O^+, HSO_4^-, $HOOCCOO^-$, and H_3PO_4), give substantially deviant catalytic coefficients, in a pattern similar to that generated by other A-S_E2 reactions. For

hydronium ion, the overall solvent isotope effect k_H/k_D, is 2.55 ± 0.10. The competitive isotope effect, $\mathscr{H}_H/\mathscr{H}_D$, is 6.84 ± 0.06. Taken with the model in which the proton is transferred directly from the H_3O^+ unit of the solvated proton to the substrate, a secondary isotope effect, $(k_H/k_D)_{II}$, of 0.54 and an isotopic α, α_1, of 0.83 ± 0.11 are obtained. These parameters are sufficient to successfully predict the rate at all intermediate isotopic compositions. For difluoroacetic acid, bisulfate ion, and phosphoric acid the solvent isotope effects and competitive isotope effects were also determined. On the basis of the direct proton transfer model, the solvent isotope effect k_{HA}/k_{DA}, is essentially equal to $(k_{HA}/k_{DA})_I$, $(\mathscr{H}_{HA}/\mathscr{H}_{DA} \times \phi_{HA})$, for the monobasic acids. For phosphoric acid a substantial secondary isotope effect was observed, k_H/k_D is 3.5 and $\mathscr{H}_H/\mathscr{H}_D$ is 6.88. To establish the source of the secondary effect, the fractionation factor, ϕ_2, for phosphoric acid, 0.83 ± 0.01, was determined from proton magnetic resonance shifts of $H_2PO_4^-$ in H_2O-D_2O mixtures. From this ϕ_1 is 0.71 ± 0.01. On the basis of these isotopic fractionation factors, the rate constants for phosphoric acid in isotopically mixed solvents were successfully predicted. A value of ϕ_3 was also calculated and an explanation of its anomalously low value, 0.55, is presented. (Disser. Abstr.)

24179 THERMODYNAMIC EQUILIBRIUM IN A LITHIUM HYDRIDE–HYDROGEN SYSTEM CONTAINING ISOTOPIC IMPURITIES. Ryskin, G. Ya.; Stepanov, Yu. P. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz., 56: 541-50(Feb. 1969). (In Russian).

Thermodynamic equilibrium between gaseous hydrogen and crystalline lithium hydride was investigated experimentally for a low concentration of D or of H and at temperatures between 230 and 670°C. A deviation of the isotope separation coefficient by 30 to 40% from the classical value of unity can be explained by quantum effects in the gas and condensed phases. An approximate method for calculating the crystal contribution to the isotope separation effect is considered. The experimental values of α are in satisfactory agreement with the theoretical values obtained earlier, and in the present investigation by an approximation method. (auth)

24180 UNIMOLECULAR THERMAL DECOMPOSITION OF AZOMETHANE-d_6. Chang, Do-ren. Chapel Hill, N. C., Univ. of North Carolina, 1968. 88p.

Thesis.

The unimolecular thermal decomposition of azomethane-d using nitric oxide as an inhibitor, was studied at three different temperatures between 256 and 297°C and at six different pressures between 1 mm and 150 mm of Hg. The rate constant has the form of an Arrhenius expression with activation energy of 51.3 kcal/mole and pre-exponential factor of $10^{15.7}$ sec^{-1} at the high pressure limit. This differs from the most recent data for azomethane, with an activation energy of 55.5 kcal/mole and pre-exponential factor of $10^{17.3}$ sec^{-1}, which might be caused by underestimating the secondary reaction in this complex decomposition reaction. The unimolecular behaviour of the net inhibited rate constant is compared with the RRKM theory in its semi-classical approximation. All vibrational degrees of freedom are taken as active. The high pre-exponential factor was interpreted via three-center bond formation mechanism. The activation energy of the deuterium abstraction in this type of reaction is reported for the first time, and is about 12 kcal/mole, with pre-exponential factor $10^{12.4}$ cc sec^{-1} $mole^{-1}$. (Disser. Abstr.)

24181 REACTIONS OF 2.8 ev TRITIUM ATOMS WITH METHANE. Chou, Chun-chao. Irvine, Calif., Univ. of California, 1968. 145p.

Thesis.

Tritium atoms with 2.8-eV laboratory energy produced by photodissociation of TBr at 1849 Å were allowed to react with methane. Both the abstraction reaction to form HT and the substitution reaction to form CH_3T were observed. The HT/CH_3T ratio in Br_2-scavenged systems is 3.8 ± 0.4 at low Br_2 mole fractions and decreases to 3.0 ± 0.2 at high Br_2 mole fractions. The HT/CH_3T ratio is related to the reaction cross sections for the abstraction and the substitution reactions. Crude estimates combined with the HT/CH_3T ratio of 0.8 and 50% hot yield in recoil tritium reactions with methane, suggest that about 10% of the substitution reaction and half of the abstraction reaction in recoil tritium systems occur below 2.8 eV. Similar experiments on 2.8-eV tritium atoms with deuterated methanes, and with pairs of isotopic methanes show: (a) a factor of 1.4 to 2.0 in favor of abstraction of H by T over D, both inter- and intramolecularly, (b) the yield of the substitution reaction decreases with increasing number of deuterium atoms in the methane molecules, and (c) the ratio T-for-H/T-for-D is nearly statistical in intramolecular competition. A "nonequilibrium state" mechanism for low energy tritium atom reactions is proposed to explain the observed results in the photochemical systems. (Disser. Abstr.)

24182 A STUDY OF TERNARY HYDRIDE PHASES FORMED BY REACTION OF LiH AND SELECTED METALS. Chang, Frank Chiang. Denver, Univ. of Denver, 1968. 59p.

Thesis.

Nineteen metallic elements were reacted with LiH to determine whether or not ternary hydride phases similar to Li_4RhH_4 and Li_4RhH_5 exist for other metal–lithium–hydrogen systems. Reactions were carried out either under vacuum or under a known pressure of H (up to 1 atm) in a Sieverts apparatus. The starting material in most cases was 4 to 1 molar ratio mixture of LiH and the metal in powder form. The maximum temperature employed was 800°C. Under these experimental conditions no reaction was observed between LiH and the metals Fe, Co, Ni, Cu, Mo, Ru, W, Re, and Os. Reactions were observed for Al, Nb, Ag, Ce, Au, Pb, and Th. The products obtained in these cases were nonhomogeneous and in low yield. There was some evidence that Al, Nb, Ce, and Th formed binary hydrides. No evidence was found that these metals or Ag, Au, or Pb formed ternary hydrides. Most likely Ag, Au, and Pb formed intermetallic compounds with Li. The product phases were too complex to identify the specific compounds formed. The metals Ir, Pd, and Pt formed both ternary hydrides and intermetallic compounds. Under vacuum Ir formed LiIr and the hydride. Under H_2 the formation of LiIr was suppressed and only the hydride of the proposed simplest formula Li_4IrH_6 was formed. Palladium formed both LiPd and a hydride of proposed simplest formula Li_4PdH_4 under vacuum and under H_2. Platinum formed both Li_2Pt and the proposed hydride Li_4PtH_6 under vacuum and under H_2. Since Rh does not form LiRh under these conditions, it is concluded that the stability of the intermetallic compounds of these elements with Li, relative to the ternary hydride phases, increases with atomic number in the second and third long periods. (Disser. Abstr.)

24183 KINETICS OF THE THERMAL EXCHANGE OF IODINE WITH SUBSTITUTED IODOBENZENES. Mok, Chup Yew. Eugene, Oreg., Univ. of Oregon, 1968. 142p.

Thesis.

The isotope exchange reaction of iodine with iodobenzene, p-iodoanisole, and p-iodonitrobenzene in the solvents hexachlorobutadiene-1,3 and nitrobenzene was studied in the temperature range 147 to 190°C. Conventional techniques for isotope exchange experiments were employed. Iodine-131 was used as the tracer. The radioactive iodine was initially incorporated only in the element, and the reaction was followed by measuring the fraction of radioactivity that became organically bound. The reaction is first order in the organic iodide and half order in iodine. It is accelerated by the p-methoxy group, but only slightly retarded by the p-nitro group. In nitrobenzene, the reaction was complicated by the presence of heterogeneous effects. Although attempts were made to eliminate such effects, it is not entirely clear that the final results can be attributed solely to a homogeneous process. Decomposition of the organic iodides occurred in the solvent hexachlorobutadiene and gave rise to increases in iodine concentration. The decomposition reactions are close to first order in the organic iodides, but independent of iodine concentration. As in the case of exchange, the p-methoxy group speeds up the reaction, and the p-nitro group slows it down. No decomposition reaction was observed in nitrobenzene. A mechanism for the exchange reaction has been proposed by which the critical step is the direct displacement (electrophilic in character) of the iodine in the aromatic iodide by an attacking iodine atom; the transition state of this step probably resembles a σ-complex. In the case of p-iodonitrobenzene, it is believed that the nitro group conjugates with the π electrons of the hexadienyl radical in the transition state, and thus promotes the rate of exchange. Possible effects of solvents are also discussed. (Disser. Abstr.)

24184 INFLUENCE OF D_2O ON THE VISCOSIMETRIC PROPERTIES OF WHEAT GLUTEN DISPERSIONS. Kaczkowski, J.; Vakar, A. B.; Demidov, V. S.; Zabrodina, T. M. (Agricultural Univ., Warsaw). Bull. Acad. Polon. Sci., Ser. Sci. Biol., 16: 473-8(1968).

The influence of D_2O treatment on the rheological changes of gluten, indicating the basic role of hydrogen bonds in the gel structure of gluten, was studied. The structural differences in dispersed gluten samples of various baking qualities as well as the influence of some factors on these proteins are described. Glutens from 3 kinds of wheat flours differing significantly in baking quality were used. Specific hydrodynamic volumes for glutens of various baking qualities were not identical. The lowest value was obtained with strong gluten, and the highest one with normal gluten (higher than in the case of weak gluten, probably because of the less compact molecule of weak gluten in the dis-

persion). D_2O slightly lowered the specific hydrodynamic volume for samples without any additives and to a greater extent for samples in the presence of urea or disulfite. This lowering was explained by the substitution of weak H bonds in protein molecules by means of stronger D bonds, which caused higher compactness of the molecules. With urea, a significant increase of asymmetry was observed, explained by the unfolding of polypeptide chains as a consequence of splitting of H bonds. (BBB) (TSS)

24185 SEPTIVALENT NEPTUNIUM AND PLUTONIUM. Mefod'eva, M. P. (Inst. of Physical Chemistry, Moscow). Priroda. No. 10, 70-2(Oct, 1968). (In Russian).

The production of Np(VII) by passing a rapid stream of ozone through a 2 to 3M basic solution of Np(VI) as indicated by spectral changes including formation of bands at 410 and 625 nm was reported previously. Similar experiments produced a new band 635 nm when Pu was oxidized by the same means from Pu(IV) to Pu(III). Neptunium(VII) was found to be oxidized by persulfate, periodate, XeO_3, perxenate, hypochlorite, hypobromite, and Na bismuthate, as well as electrochemically. The new valence states have strong oxidizing properties. Compounds prepared are $Ba_3(NpO_5)_2$, $Sr_3(NpO_5)_2$, $(Co(NH_3)_6)NpO_5 \cdot 3H_2O$, and $(Pt(NH_3)_5Cl)NpO_5 \cdot H_2O$. Results of a search for the cationic form NpO_2^{+3} are described. (BBB)

24186 DEUTERIUM ISOTOPE EFFECT IN ZERO-FIELD SPLITTINGS OF PHOSPHORESCENT PHENANTHRENE ORIENTED IN BIPHENYL. Gerkin, Roger E.; Winer, Arthur M. (Ohio State Univ., Columbus). J. Chem. Phys., 50: 3114-15 (Apr. 1, 1969).

Low-field precision determinations of the zero-field splittings of phosphorescent phenanthrene-h_{10} and phenanthrene-d_{10} oriented singly and together in single crystals of biphenyl at ~77°K established a deuterium isotope effect whose magnitude, though small, was substantial relative to the uncertainty of the measurements. It was tentatively concluded that the isotope effect is primarily an intramolecular effect and is not due primarily to the guest–host interactions on deuteration of the guest. (M.C.G.)

24187 SECONDARY AND SOLVENT KINETIC ISOTOPE EFFECTS OF THE E2 REACTION IN PROTIUM AND DEUTERIUM OXIDES. Winey, Donald Alfred. Philadelphia, Univ. of Pennsylvania, 1968. 211p.

Thesis.

The present study was designed to add information concerning the nature of the E2 transition state and the effects of substituents on transition state geometry. A series of trimethylammonium-phenylethyl-x derivatives was synthesized, x = Br, Cl, F, S^+Me_2, $N^+Me_2C_6H_5$, N^+Me_3. (All cations were p-toluenesulfonate, TsO^-.) The rates of reaction were measured at 60°C by the disappearance of base with hydroxide–protium oxide and deuteroxide–deuterium oxide as the base-solvent. The ratio of the rate constants gave the observed secondary kinetic isotope effect, $(k_{OD^-}/k_{OH^-})_{obs}$; Br, 1.30 ± 0.02; Cl, 1.40 ± 0.03; F, 1.67 ± 0.03; S^+Me_2, 1.55 ± 0.02; $N^+Me_2C_6H_5$, 1.68 ± 0.02; N^+Me_3, 1.62 ± 0.12. A determination of the solvent isotope effect was made for x = Br and S^+Me_2 by observing the reaction rates with phenoxide as base in protium and deuterium oxides, k_{D_2O}/k_{H_2O}; Br, 1.11 ± 0.07; S^+Me_2, 1.25 ± 0.08. The relationship of the observed secondary kinetic isotope effect, the corrected secondary kinetic isotope effect, and the solvent kinetic isotope effect was shown to be $(k_{OD^-}/k_{OH^-})_{obs} = (k_{OD^-}/k_{OH^-}) \cdot (k_{D_2O}/k_{H_2O})$. Using the bromide solvent effect for the halide and the dimethylsulfonium solvent effect for the -onium leaving groups the corrected secondary kinetic isotope effects (k_{OD^-}/k_{OH^-}) were calculated as Br, 1.17; Cl, 1.26; F, 1.50; S^+Me_2, 1.55; $N^+Me_2C_6H_5$, 1.34; N^+Me, 1.30 (standard deviations estimated as ca. ± 0.11). The observance of considerable variation in the secondary isotope effect for the E2 reaction is persuasive evidence for variations in the extent of bond formation between the base and β-hydrogen. The maximum k_{OD^-}/k_{OH^-} is expected for the case where the β-hydrogen is completely transferred to the base in the transition state and is calculated from the equilibrium base strengths of OC^- and OH^- to be 1.96 at 60°. For the case of half transfer of the β-hydrogen in the transition state, the value is calculated as $1.96^{0.5}$ or 1.40. The extent of β-hydrogen transfer to the base increases in the series of leaving groups Br < Cl < S^+Me_2 < N^+Me_3 < $N^+Me_2C_6H_5$ < F. This is interpreted as a shift of the transition state geometry from a reactant-like structure for the bromide leaving group to a product-like one for the fluoride leaving group. The empirical Hofmann–Saytzeff Orientation Rules are discussed on the basis of the variable E2 transition state and substituent effects on the geometry of the transition state. It is concluded that the Hofmann–Saytzeff rules are a reflection of the product-like or reactant-like character of the transition state, respectively, and that the variations observed in the product ratios with changing substituents and/or conditions can be explained by shifts in the transition state geometry. (Disser. Abstr.)

24188 HYPERFINE STRUCTURE OF $HD^{17}O$ BY BEAM-MASER SPECTROSCOPY. Verhoeven, J.; Dymanus, A.; Bluyssen, H. (Katholieke Univ., Nijmegen, Netherlands). J. Chem. Phys., 50: 3330-8(Apr. 15, 1969).

Hyperfine structure of the $2_2 \rightarrow 2_1$ rotational transition of $HD^{17}O$ at 10.374 GHz was investigated with a beam-maser spectrometer. The best-fit results for the spin-rotation coupling constants $C_{jr}^{(K)}$ and for the components $\chi_{ij}^{(K)}$ of the quadrupole coupling tensors in their principal coordinate systems are in kHz: $C_{2_2}^{(H)} = -42.20 \pm 0.20$; $C_{2_1}^{(H)} = -42.98 \pm 0.20$; $C_{2_2}^{(D)} = -2.04 \pm 0.02$; $C_{2_1}^{(D)} = -2.0000 \pm 0.0015$; $C_{2_2}^{(O)} = -22.5 \pm 0.3$; $C_{2_1}^{(O)} = -22.35 \pm 0.20$; $\chi_{xx}^{(O)} = 10\,175 \pm 67$; $\chi_{yy}^{(O)} = -8891 \pm 21$; $\chi_{zz}^{(O)} = -1283 \pm 87$; $\chi_{x'x'}^{(D)} = 307.90 \pm 0.14$; $\chi_{z'z'}^{(D)} = -133.13 \pm 0.14$; $\chi_{y'y'}^{(D)} = -174.78 \pm 0.29$; $\eta^{(O)} = (\chi_{zz}^{(O)} - \chi_{yy}^{(O)})/\chi_{xx}^{(O)} = 0.75 \pm 0.01$. These results show good agreement with recent ab initio calculations and remove the discrepancy with the experimental results of Stevenson and Townes ($\eta^{(O)} = 1.83 \pm 0.20$). (auth)

24189 INFRARED SPECTRA AND GEOMETRY OF SO_2 ISOTOPES IN SOLID KRYPTON MATRICES. Allavena, M. (Univ. of Pennsylvania, Philadelphia); Rysnik, R.; White, David; Calder, V.; Mann, D. E. Contract ONR-N00014-67-A-0216-0001. J. Chem. Phys., 50: 3399-3409(Apr. 15, 1969).

The infrared spectra of the ^{32}S, ^{34}S, ^{16}O, ^{18}O isotopic species of SO_2 trapped in solid krypton matrices at 20°K are reported. Under conditions of medium resolution (~ 0.8 cm^{-1}), single bands are observed in each of the spectral regions which correspond to the three vibrational modes. Analysis of all the matrix data on the basis of a valence force field which includes anharmonic corrections and in which the bond angle is treated as a variable parameter yields force constants very close to those derivable from the available gas-phase data. The SO_2 bond angle which leads to the best fit of the experimental matrix data is 119°37′, in excellent agreement with the angle determined from microwave data. The use of measured isotopic shifts for the determination of the bond angles in triatomic molecules both from matrix and gas-phase studies is examined in considerable detail. It is shown that the use of observed frequencies in calculations involving two isotopic species can lead in many cases to reliable upper and lower limits of the bond angle. The quality of these limits depends on the magnitude of the anharmonic corrections and the stretch-bend interaction. The infrared spectra of matrix isolated SO_2 and NO_2 under conditions of higher resolution (0.3 cm^{-1}) reveal some interesting features in the asymmetric stretching mode ν_3. These features are discussed in terms of a hindered rotation in the solid krypton matrix. (auth)

24190 H–D ISOTOPE EFFECTS AT HYDROGEN BRIDGES BETWEEN ALCOHOLS AND TERTIARY AMINES. Kolbe, A. (Martin-Luther Univ., Halle, Ger.). Tetrahedron Lett., 13: 1049-52(Mar. 1969). (In German).

Ratios of equilibrium constants at 25 ± 0.5°C for association between tertiary amines and alcohols with and without deuterium-labeled OH were determined by ir spectroscopy in toluene. Results to an accuracy of ±20% or better are given for every combination of five alcohols and nine amines. (UK)

24191 SOLVENT ISOTOPE EFFECTS AND TRANSITION-STATE SOLVATION IN THE BASIC METHANOLYSIS OF ESTERS. Mitton, Carl G.; Gresser, Michael; Schowen, Richard L. (Univ. of Kansas, Lawrence). J. Amer. Chem. Soc., 91: 2045-7(Apr. 9, 1969).

Aryl methyl carbonates and aryl acetates undergo methoxide-catalyzed methanolysis in CH_3OD 1.5 to 2.1 times faster than in CH_3OH. The magnitudes of isotope effects and entropies of activation indicate that the gross isotope effects originate in an increase in structure of the solvent as methoxide ion partially adds to the substrate carbonyl groups, probably accompanied by an increase in solvent librational frequencies. The substituent-induced variations in the isotope effects and entropies of activation are most easily interpreted as involving changes in hydrogen-bonding strength for solvent molecules. (auth)

24192 ISOTOPE EXCHANGE AND SOLVOLYSIS IN THE BASIC METHANOLYSIS OF ARYL ESTERS. MOLECULAR INTERPRETATION OF FREE ENERGIES, ENTHALPIES, AND ENTROPIES OF ACTIVATION. Mitton, Carl G.; Schowen, Richard L.; Gresser, Michael; Shapley, John (Univ. of Kansas, Lawrence). J. Amer. Chem. Soc., 91: 2036-44(Apr. 9, 1969).

The free energies of activation for methoxide-catalyzed methanolysis of aryl acetates and carbonates in methanol are not linearly related to the free energies of ionization of the corre-

sponding phenols; instead the rate process becomes less sensitive to substituent as the electron-withdrawing power of the substituent increases. This is not due to a change in rate-determining step from phenoxide elimination of the tetrahedral intermediate with poor leaving groups to carbonyl addition with good leaving groups, because methoxyl-labeled aryl methyl carbonates, $CH_3OCO_2C_6H_4X$, undergo basic methanolysis without methoxyl exchange regardless of the character of X(X = p-CHO, H, p-CH_3O). A plot (slope 1.8) of free energies of activation vs. (0.80F + R), where F and R are the field effect and resonance constants of Swain and Lupton, is linear, consistent with the attribution of the curvature in the other plots to greater importance of the resonance interaction in the equilibrium than in the rate process. Alternatively, the length of the transition-state nucleophile–carbonyl bond may increase with electron withdrawal in the leaving group. The substituent effect appears neither in the enthalpy of activation alone nor in the entropy of activation alone, but rather both vary and there is not a linear relation between them. The substituent points in the enthalpy-entropy plane may be represented by vector sums of isergonic ("isokinetic") relations, one having a slope of 330°K, presumably resulting from substituent effects on solvation, and one having a very large slope, presumably resulting from substituent effects on internal energy. The solvation effects essentially disappear from the free energies of activation at 298° (near 330°) and the free energy relations thus arise from internal energy interactions. (auth)

24193 DETERMINATION OF THE STRUCTURES OF THE IONS PRODUCED IN THE SINGLE AND DOUBLE MCLAFFERTY REARRANGEMENTS BY ION CYCLOTRON RESONANCE SPECTROSCOPY. Diekman, John; MacLeod, J. K.; Djerassi, Carl; Baldeschwieler, J. D. (Stanford Univ., Calif.). J. Amer. Chem. Soc., 91: 2069-84(Apr. 9, 1969).

Two possible structural isomers of the $C_3H_6O^{\cdot+}$ ion produced by electron impact induced fragmentations are the keto ion and the enol ion. The electron impact induced "double McLafferty" rearrangement can also produce a $C_3H_6O^{\cdot+}$ ion which could conceivably exist in either the enol or symmetrical oxonium ion structure. Ion cyclotron resonance and pulsed double resonance spectroscopy are used to study the ion–molecule reactions of the keto species, generated from acetone; the enol species, generated from 2-hexanone (via a McLafferty rearrangement) and from 1-methylcyclobutanol, and the double McLafferty species, generated from 5-nonanone. Seven ion-molecule reactions are found which distinguish between the keto and enol ions, thus substantiating the proposed differences in structure. In all cases studied, the enol ion, from 2-hexanone, and the enol ion, from 1-methylcyclobutanol, behave identically indicating their structures to be equivalent. The same ion-molecule reactions which distinguish between the keto and enol isomers can be utilized to distinguish between the keto and double McLafferty species. The enol and double McLafferty species react identically in all systems studied thus suggesting identical structures and raising serious doubts about the earlier proposed existence of a symmetrical double McLafferty oxonium ion. Deuterium labeling is employed to distinguish between isomeric ions of identical mass. (auth)

24194 FAVORSKII REARRANGEMENTS. III. FURTHER EVIDENCE FOR AN IONIZATION-π-PARTICIPATION MECHANISM. Bordwell, F. G.; Scamehorn, Richard G.; Springer, Wayne R. (Northwestern Univ., Evanston, Ill.). J. Amer. Chem. Soc., 91: 2087-93(Apr. 9, 1969).

From deuterium exchange and rate data it is shown that the conversion of $ArCH_2COCH_2Cl$ (2) to $ArCH_2CH_2CO_2Me$ with 0.05 M NaOMe in MeOH at 0°C involves reversible carbanion formation, and that $\rho = -4.97$ for the first-order release of chloride ion from this carbanion. The rate of chloride ion release exhibits a positive salt effect, but no common ion effect. Dilution of the methanol with water gave an appreciable rate acceleration (Grunwald–Winstein m = 0.647). $ArCHClCOCH_3$ (1) compounds responded similarly to salt and solvent effects; evidence is presented to show that isomerization of 1 to 2 (or vice versa) does not precede rearrangement. The data allow exclusion of seven mechanisms for these reactions. The favored mechanism remaining is one involving ionization of the C–Cl bond aided by π participation on the part of the neighboring enolate ion. (auth)

24195 PROTONATED NITROXIDE FREE RADICAL. Hoffman, Brian M.; Eames, Thomas B. (Northwestern Univ., Evanston, Ill.). J. Amer. Chem. Soc., 91: 2169-70(Apr. 9, 1969).

While investigating the interaction between organic free radicals and Lewis acids it was found that an aliphatic nitroxide could be protonated without destroying the paramagnetic center. A strong Lewis acid can coordinate with residual water in an organic solvent, giving a complex which acts as a strong Brønsted acid and protonates the nitroxide. The ESR spectra of the protonated nitroxide and the deuterated nitroxide are shown. (D.H.M.)

24196 MICROWAVE SPECTRUM AND STRUCTURE OF CYCLOPROPANONE. Pochan, J. M.; Baldwin, J. E.; Flygare, W. H. (Univ. of Illinois, Urbana). J. Amer. Chem. Soc., 91: 1896-8(Apr. 9, 1969).

The microwave spectra of $^{13}C_1$, $^{13}C_2$, and 2,2-dideuteriocyclopropanone were observed in the ground vibrational state. The ground-state rotational constants for the $^{13}C_1$ species are A = 20155 ± 10 MHz, B = 7457.3 ± 0.3 MHz, and C = 5866.2 ± 0.2 MHz. The ground-state rotational constants for the $^{13}C_2$ species are A = 19685 ± 5 MHz, B = 7370.60 ± 0.05 MHz, and C = 5772.29 ± 0.04 MHz. The ground-state rotational constants for the 2,2-dideuterio species are A = 17005.0 ± 6 MHz, B = 6960.8 ± 0.1 MHz, and C = 5477.91 ± 0.09 MHz. The structural parameters obtained from the spectral data for the isotopically normal cyclopropanone and the three isotopically labeled species are: C–H = 1.086 ± 0.025 Å, C_1-C_2 = 1.475 ± 0.017 Å, C_2-C_3 = 1.575 ± 0.012 Å, C–O = 1.191 ± 0.021 Å, $C_1C_2C_3$ angle = 57° 42′ ± 25′, HCH angle = 114 ± 2°, and HCH plane angle with C_2-C_3 axis = 29 ± 2°. (auth)

24197 THERMAL DECOMPOSITION OF BIPHENYL AT 400°C. Lutz, Michel (CEN de Saclay, Gif-sur-Yvette, France). J. Chim. Phys., 66: 365-75(Feb. 1969). (In French).

The pyrolysis of highly purified diphenyl was studied in the gas phase and in gas–liquid mixed phases at 400°C. The experiments were performed in bulbs sealed in vacuo and the degree of decomposition never exceeded 0.1%. The principal products found were hydrogen, benzene, terphenyls, and a deposit of polyphenyls. Small quantities of methane, ethane, ethylene, and acetylene were also measured but no tetraphenyl was detected. The yields of the products are presented as a function of the pyrolysis time, the state (liquid or gas), and the diphenyl pressure. In the absence of liquid the pyrolysis occurs in the adsorbed phase and metal walls are more effective than glass or silica in promoting the reaction. A mechanism for the degradation and synthesis of higher polyphenyls in the adsorbed state based on the formation and reactions of phenyl radicals is proposed. Experiments in which phenyl radicals were produced by the decomposition of mercury diphenyl lend support to the hypothesis. (auth)

24198 ISOTOPE EFFECT ON THE HYDROGEN-BOND LENGTH. Singh, T. R.; Wood, J. L. (Imperial Coll. of Science and Tech., London). J. Chem. Phys., 50: 3572-6(Apr. 15, 1969).

Using the Stepanov approximation, computer calculations were made of the effect of deuterium substitution on the length of the hydrogen bond. Expansion on replacement with deuterium is a feature of both symmetric and asymmetric double-minimum potentials, contraction of single-minimum potentials. The origin of the effect and its relation to observations is discussed. (auth)

24199 PROTON MAGNETIC RESONANCE SOLVATION STUDY OF $Sc(NO_3)_3$, $Y(NO_3)_3$, AND $Th(NO_3)_4$ IN WATER–ACETONE MIXTURES. Fratiello, Anthony; Nishida, Vone M.; Lee, Robert E.; Schuster, Ronald E. (California State Coll., Los Angeles). J. Chem. Phys., 50: 3624-8(Apr. 15, 1969).

Cation coordination measurements of $Sc(NO_3)_3$, $Y(NO_3)_3$, and $Th(NO_3)_4$ in water–acetone mixtures have been made by a proton magnetic resonance method. At low temperatures, solutions of these salts exhibited separate proton resonance signals for bulk water and water molecules in the primary solvation shell of the cation. Integration of these signals provided a direct measure of the number of water molecules coordinated to the cation. Values of 3.9, 2.4, and 2.9 were obtained for Sc(III), Y(III), and Th(IV), respectively, over a range of salt and solvent concentrations. These values may reflect extensive ion pairing in these solutions, particularly in the Y(III) and Th(IV) cases. The PMR spectra of Th(IV) solutions revealed multiple signals for the protons of coordinated water molecules, lending evidence to the postulate of ion pairing in these systems. (auth)

24200 REACTION OF CUBIC CARBIDES OF Ti, V, Nb, AND Ta WITH Be. Zainulin, Yu. G.; Alyamovskii, S. I.; Shveikin, G. P.; Shchetnikov, E. N.; Gel'd, P. V. Zh. Prikl. Khim., 42: 693-5(Mar. 1969). (In Russian).

The results of x-ray phase analyses of reactions of Ti, V, Nb, and Ta carbides with Be at 1500°C in a vacuum showed that limited cubic solid solutions of the NaCl-type are formed by the substitution–diffusion process. Completely homogeneous reactions between titanium carbide and Be were not obtained. (R.V.J.)

24201 CONVERSION OF UF_6 TO UO_2 IN A FLAME REACTOR. Federer, J. I.; Robinson, W. C. Jr.; Patterson, F. H. (Oak Ridge National Lab., Tenn.). Nucl. Appl., 6: 298-306(Apr. 1969).

The feasibility of preparing UO_2 powder in a flame reactor was demonstrated by reacting UF_6 with hydrogen and oxygen. The reaction was conducted with stoichiometric quantities of reactants and with mixtures containing excess hydrogen or oxygen. The reaction was self-sustaining after ignition with an HF flame, which

was used in initial experiments to supply heat for the reaction. X-ray diffraction of the powder product indicated that UO_2 and U_3O_8 were the principal reaction products, occurring sometimes with other compounds. The crystallite size of as-prepared powder ranged from about 0.012 to 0.038 μm; however, sieve analyses showed that the powder was highly agglomerated. The as-prepared powder contained approximately 4 to 14 wt % F, but heat treatment at 1000°C in hydrogen reduced the fluorine content to ≤30 ppM. The defluorination heat treatment increased the crystallite size to about an order of magnitude. Pellets pressed from defluorinated powder sintered to 95% of theoretical density of 1400°C. (auth)

24202 REACTION OF EXO-TRICYCLO[3,2,1,$0^{2,4}$]OCTENE WITH RHODIUM CATALYSTS. Katz, Thomas J.; Cerefice, Steven (Columbia Univ., New York). J. Amer. Chem. Soc., 91: 2405-6(Apr. 23, 1969).

A study of the reaction of exo-tricyclo[3.2.1.$0^{2,4}$]octene with rhodium catalysts was made that may prove false the previous assumption that the reaction is an electrocyclic process. Products and intermediates are formed that have no place in the previous mechanistic scheme and must be accounted for in a different way. In the study NMR spectra of normal and deuterated exo-tricyclo-[3.2.1.$0^{2,4}$]octene are compared. (D.H.M.)

24203 NUCLEAR MAGNETIC RESONANCE STUDIES OF CONFORMATION AND RING INVERSION IN THE [3,3]PARACYCLOPHANE SYSTEM. Anet, F. A. L.; Brown, Mary A. (Univ. of California, Los Angeles). J. Amer. Chem. Soc., 91: 2389-91 (Apr. 23, 1969).

Variable-temperature NMR data are reported on normal and partly deuterated [3.3]paracyclophane. Results show that in solution [3.3]paracyclophane exists as a mixture of boat and chair conformations in the ratio of about 2:1, and that the free-energy barrier for the boat-chair conversion is about 11.7 kcal/mol. (D.H.M.)

24204 NEIGHBORING SULFONIUM GROUP IN ESTER HYDROLYSIS. II. Casanova, Joseph Jr.; Rutolo, David A. Jr. (California State Coll., Los Angeles). J. Amer. Chem. Soc., 91: 2347-50(Apr. 23, 1969).

Hydrolysis of methyl dimethylsulfonium acetate p-toluenesulfonate at constant pH is shown to be first order in hydroxide ion and first order in ester in the range of pH 7 to 8.5. The entropy of activation is +17 ± 2.3 eu. Evidence is presented which suggests that the unusual value for $\Delta S^{\ddagger}$ involves a sulfonium hydroxide intimate ion pair. Methylene proton exchange was also studied. (auth)

24205 MECHANISM OF THE REACTION OF METHYLENE HALIDES WITH ALKALI METAL ALKOXIDES IN ALCOHOL SOLUTION. Hine, Jack; Duke, Roy B.; Glod, Edward F. (Georgia Inst. of Tech., Atlanta. Ohio State Univ., Columbus). J. Amer. Chem. Soc., 91: 2316-24(Apr. 23, 1969).

Rate constants were determined for the nucleophilic substitution reactions of methylene chloride, bromochloromethane, methylene bromide, and methylene iodide with sodium methoxide in methyl alcohol and methyl alcohol-d, with potassium isopropoxide in isopropyl alcohol and isopropyl alcohol-d, and with potassium t-butoxide in t-butyl alcohol and t-butyl alcohol-d. For a given methylene halide the rate constants increase by about fourfold on going from sodium methoxide to potassium isopropoxide and then decrease somewhat on going to potassium t-butoxide. The rate constant for chloroform, which is known to react by an α-elimination mechanism, increases by 700-fold on going from sodium methoxide to potassium isopropoxide and by another 140-fold on going to potassium t-butoxide. The rate constants for the alkoxide ion catalyzed deuterium exchange of the methylene halides increase by about 300-fold on going from sodium methoxide to potassium isopropoxide and by about another 20-fold on going to potassium t-butoxide. These reactivity data show that an α-elimination mechanism is improbable for the reaction of methylene halides with alkoxide ions in alcohol solution. The reaction mechanism is probably largely SN2, with the reactivity of the t-butoxide ion and to a lesser extent that of the isopropoxide ion being decreased by steric hindrance. The SN2 mechanism is further supported by the fact that 0.5M sodium iodide does not decrease the rate of reaction of methylene iodide with sodium methoxide and the fact that methylal isolated from the reaction of methylene bromide with sodium methoxide in methyl alcohol-d contains only about that small amount of deuterium that would result from deuterium exchange of the methylene bromide before its transformation to methylal. The rate constants for reaction of a given methylene halide with a given alkali metal alkoxide are 1.66 ± 0.15 times as large in the deuterated alcohol as in the protiated alcohol. (auth)

24206 SOLVOLYTIC STUDIES OF BICYCLOOCTENYL DERIVATIVES. THE EPIMERIC BICYCLO[3,2,1]OCT-6-EN-3-YL TOSYLATES. LeBel, Norman A.; Maxwell, Robert J. (Wayne State Univ., Detroit). J. Amer. Chem. Soc., 91: 2307-15(Apr. 23, 1969).

The synthesis and characterization of exo(equatorial)-bicyclo [3.2.1]oct-6-en-3-ol, endo(axial)-bicyclo-[3.2.1]oct-6-en-3-ol, and derivatives thereof are reported. Analysis of the kinetic data from the acetolyses of these compounds and their β-tetradeuterated analogs suggests that the rates are "normal" for these constrained cyclohexyl tosylates; no anchimeric assistance seems to be provided by the double bond for the exo isomer, or by the axial β-hydrogen for the endo isomer. Preparative solvolyses show that the reaction mixtures contain products of elimination, substitution without skeletal rearrangement, as well as rearranged products. The rearranged acetates arise from the tricyclo[3.2.1.$0^{2,7}$]octan-6-yl cation, and this intermediate is generated by way of a stereospecific hydride-shift pathway. A hydrogen-bridged intermediate cation, intervening after the first-formed ion pair, nicely accommodates the data. Secondary acetolysis products are encountered as well, and mechanisms for their formation are proposed. (auth)

24207 PREFERENTIAL SOLVATION AND THE MECHANISMS OF THERMAL AND PHOTOCHEMICAL SOLVOLYSIS OF THE HEXATHIOCYANATOCHROMATE(III) ION IN ACETONITRILE–WATER MIXTURES. Behrendt, Stefan; Lanford, Cooper H.; Frankel, Lawrence S. (Carleton Univ., Ottawa. Univ. of Massachusetts, Amherst). J. Amer. Chem. Soc., 91: 2236-9(Apr. 23, 1969).

The NMR method for determining the composition of the solvation shell of a paramagnetic solute introduced by Frankel, Stengle, and Langford was applied to reveal the strong preference of $Cr(NCS)_6^{3-}$ for CH_3CN in CH_3CN-H_2O mixtures. The rate of loss of the first SCN^- from this complex was measured as a function of solvent-shell composition. The thermal solvolysis reaction rate decreases linearly with the fraction of water (the reactive solvent) in the solvation shell revealing the requirement for one water molecule as a stoichiometric component of the transition state. Solvolysis by D_2O, methanol, and pyridine proceeds at nearly the same rate as hydrolysis. The corresponding photolysis is nearly independent of solvent-shell composition. A dissociative interchange mechanism for thermal solvolysis would explain these results. The photoexcited state is expected to have a lifetime sufficiently long to allow rearrangement of the solvation shell after "activation." (auth)

24208 NEODYMIUM CHLORIDE–ALUMINUM CHLORIDE VAPOR COMPLEXES. Oeye, H. A.; Gruen, D. M. (Argonne National Lab., Ill.). J. Amer. Chem. Soc., 91: 2229-36(Apr. 23, 1969).

The vaporization of solid $NdCl_3$ in the presence of Al_2Cl_6 gas was studied spectrophotometrically in the range 500 to 900°K and 1 to 7 atm. Molar absorptivity of the strongest absorption peak at 17,030 cm^{-1} was found to be 18.8 l/(mole cm). At 800°K, the apparent vapor pressure of $NdCl_3$ is increased by a factor of 3×10^3 by the presence of 1 atm of Al_2Cl_6. The large increase in volatility is rationalized in terms of the formations of neodymium chloride–aluminum chloride vapor complexes according to the reactions $NdCl_3(s) + 1.5Al_2Cl_6(g) = NdAl_3Cl_{12}(g)$ and $NdCl_3(s) + 2Al_2Cl_6(g) = NdAl_4Cl_{15}(g)$. The equilibrium quotients for the two reactions were fitted to expressions of the form $\log K = A + (B/T)$ with $A_1 = 0.547$, $B_1 = -2353$, $A_2 = -2.711$, and $B_2 = -370$. (auth)

24209 ISOTOPIC EFFECT OF DEUTERIUM ON THE KINETICS OF ALKALINE CLEAVAGE OF ACETYLACETONE. Calmon, Jean-Pierre (Faculte des Sciences, Toulouse). Compt. Rend., Ser. C, 268: 1256-8(Mar. 31, 1969). (In French).

The velocity of cleavage of acetylacetone (2,4-pentanedione) in deuteriated sodium hydroxide showed a primary isotope effect k^H/k^D in the neighborhood of 4 confirming the hypothesis of a proton transfer in the determining stage of the reaction. (tr-auth)

Radiation and Nuclear Chemistry

Refer also to abstracts 24095, 24126, 24282, 24287, 24293, 24570, 25473, 25474, and 26090.

24210 (ANL-7486) BUILDUP OF RADIOACTIVE PRODUCTS IN THERMAL REACTORS. III. ^{230}Th, ^{231}Pa, AND ^{232}Th TARGETS. Stewart, D. C.; Macias, E. S.; Basile, L. J.; Milsted, J. (Argonne National Lab., Ill.). Dec. 1968. Contract W-31-109-eng-38. 49p. Dep. CFSTI.

The production of ^{231}Pa and ^{233}U from ^{230}Th, ^{232}U from ^{231}Pa, and ^{233}U from ^{232}Th is considered. Calculations were made for seven different neutron fluxes. On irradiation of ^{230}Th, increases in flux improved the 231 chain yield, but had a sharply depressing effect for 232 masses. For irradiation of ^{231}Pa, the deleterious effect of higher fluxes was immediately apparent. The yield decreased

and other isotopes were formed. For irradiation of ^{232}Th higher fluxes were definitely beneficial in terms of increased yields, although there was a slight decrease in isotopic purity. (M.C.G.)

24211 (BARC–369) WOOD–PLASTIC COMBINATIONS. PART II. ACRYLIC ESTERS AND THEIR COPOLYMERS. Rao, K. N.; Moorthy, P. N.; Rao, M. H.; Vijaykumar; Gopinathan, C. (Bhabha Atomic Research Centre, Bombay (India)). 1968. 54p. Dep.

Studies were made on the mechanical properties of γ radioinduced wood–plastic combinations. Vellapine and silver oak, two species of soft woods, were impregnated with several monomers: acrylonitrile, methyl acrylate, ethyl acrylate, and combinations of the first monomer with the other two and also with styrene. The relative merits of the different polymers in improving the mechanical properties of vellapine and silver oak were compared. It was found that from the point of view of appearance and finish, wood–polyacrylate–acrylonitrile plastic combinations were as good as wood–poly(methyl methacrylate) combinations, which were studied previously. As far as economics are concerned, both acrylonitrile and methyl acrylate are much cheaper than methyl methacrylate. (P.C.H.)

24212 (BMwF-FBK–68-52) RADIATION INDUCED CONDUCTIVITY EFFECTS IN ORGANIC HALOGEN COMPOUNDS. Wolschendorf, K. (Kiel Univ. (West Germany). Institut fuer Angewandte Physik). Dec. 1968. 23p. (In German). Dep.

Radioinduced effects on conductivity in aqueous solutions of organic compounds were studied. The dependence of the conductivity on the applied dose was derived by means of simple reaction kinetics. Radiation effects on the solutions were determined and compared with that of the chloral hydrate system. The availability of the systems investigated for conductimetric dosimetry is discussed. (auth)

24213 (BNL–13037) RADIATION-INDUCED POLYMERIZATIONS IN CONTINUOUS STIRRED TANK REACTORS. Chen, H. T. (Newark Coll. of Engineering, N. J.); Hill, F. B. (Brookhaven National Lab., Upton, N. Y.). Oct. 1968. 36p. (CONF-690307–3). Dep. CFSTI.

From Advances in High-Pressure Technology Symposium, New Orleans, La.

A theoretical study of the performance characteristics of continuous stirred tank reactors when used to conduct radioinduced polymerizations is presented. The effects on conversion and molecular weight distribution of the interaction of radiation attenuation, chemical kinetics, and mixing are examined for initiation by ultraviolet light and by ^{60}Co gamma radiation. (auth)

24214 (CEA-CONF–1237) FRENCH RESEARCH REPORT. Chesne, A.; Berger, R. ([Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires]). [1966]. 40p. (CONF-661123–2). Dep.

From International Transplutonium Elements Symposium, Oak Ridge, Tenn.

The French Transplutonium Element Program is reviewed considering both production and research programs. (D.H.M.)

24215 (INP–662) PRODUCTION OF CARRIER-FREE RADIOISOTOPES FROM TARGETS IRRADIATED WITH DEUTERONS OR α-PARTICLES IN THE U-120 CRACOW CYCLOTRON. PART I. PREPARATION OF RADIOISOTOPES OF CADMIUM, INDIUM, AND TELLURIUM. Kopta, S.; Niewodniczanski, H.; Petryna, T.; Stronski, I. (Institute of Nuclear Physics, Krakow (Poland)). Nov. 1968. 16p. Dep.

The results of experiments on the preparation of carrier-free radioisotopes from targets irradiated in a U-120 cyclotron are presented. In the Ag(d,2n), Ag(α,xn), and Sn(α,xn) reactions the isotopes ^{109}Cd, ^{109}In, ^{110m}In, ^{111}In, ^{119}Te, ^{119m}Te, ^{121}Te and ^{121m}Te were prepared by means of ion exchange, extraction, and precipitation methods. (auth)

24216 (INP–663) PRODUCTION OF CARRIER-FREE RADIOISOTOPES FROM TARGETS IRRADIATED WITH DEUTERONS OR α PARTICLES IN THE U-120 CRACOW CYCLOTRON. PART II. PREPARATION OF RADIOISOTOPES OF GADOLINIUM, SAMARIUM, AND THULIUM FROM TARGETS OF SAMARIUM, NEODYMIUM, AND HOLMIUM. Kopta, S.; Niewodniczanski, H.; Petryna, T.; Stronski, I. (Institute of Nuclear Physics, Krakow (Poland)). Nov. 1968. 18p. Dep.

The results of experiments on the preparation of carrier-free radioisotopes of lanthanides from targets irradiated in a U-120 cyclotron are presented. In the Sm(α,2n), Nd(α,n), and Ho(α,2n) reactions the isotopes ^{143}Gd, ^{153}Sm, and ^{167}Tm were obtained. They were prepared by means of ion exchange and extraction chromatography methods. (auth)

24217 (KURRI-TR–17) PHYSICAL MEASUREMENTS IN RADIATION CHEMISTRY. [Meeting Held at Kyoto University, February 11, 1966]. Report of the Special Research Committee. Yoshida, Hiroshi (comp.) (Kyoto Univ. (Japan). Research Reactor Inst.). [1966]. 25p. (In Japanese). (CONF-660224–(Abst.)). Dep.

Abstracts of papers presented at a meeting held at Kyoto University on February 11, 1966, under the theme "Physical Measurements in Radiation Chemistry" are presented. Problems of mass spectrometry, including a review of the formation of fragmentation ions by electron impact, ionization potential, efficiency, and excitation energy are discussed. Pulse radiolysis studies, carried out at the Hokkaido University, particularly with respect to α-methylstyrene, are described. The technique of electrical conductance measurements to determine free ion formation by radiolysis, radioinduced thermoluminescence, the field of electronic spectra by the rigid solvent method, and recent paramagnetic resonance studies are included. (TTT)

24218 (LFEN-87-a) γ RADIOLYSIS OF PERDISULFURIC ACID. Mariano, M. H. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1968. 20p. (In Portuguese). Dep.

The effects of perdisulfate concentration, pH, time of irradiation, and added radical scavengers on the rate of decomposition of perdisulfuric acid, in the ^{60}Co γ-radiolysis of this compound are reported. In dilute H_2SO_4 solutions, the rate of $S_2O_8^{=}$ decomposition is very small. $G(-S_2O_8^{=})$ decreases with pH and becomes negative for $[H_2SO_4] \geq 5\underline{M}$. At constant acidity, $G(-S_2O_8^{=})$ increases with $[K_2S_2O_8]$. It is inferred that SO_4^{-} radicals compete with perdisulfate for reaction with HO_2. The reactions $SO_4^{-} + OH^{-} \rightarrow HSO_5^{-}$ and $SO_4^{-} + SO_4^{-} \rightarrow S_2O_8^{=}$ do not take place in the bulk of the solutions. The probability of the dimerization of the sulfate radical within the spurs is small as compared with the probability of occurrence of the other SO_4^{-} reactions. Perdisulfuric acid is protected against radical attack by added Br^{-} ions. (auth)

24219 (NP-tr–1761) EFFECT OF DOSE RATE ON THE KINETICS OF CYCLOHEXANE RADIOLYSIS. CYCLOHEXANE AS A CHEMICAL DOSIMETRY SYSTEM. Makarov, V. I.; Polak, L. S. Translated by R. G. P. Towndrow (Atomic Energy Research Establishment, Harwell, Eng.), from Neftekhimiya, 7: 219-23(1967). 9p. Dep. CFSTI. UK.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 30479.

24220 (NP-tr-1764) RATE CONSTANTS FOR THE REACTIONS OF CERTAIN DYES WITH HO_2 RADICALS AND HYDRATED ELECTRONS FORMED BY THE ^{60}Co γ-RADIOLYSIS OF AQUEOUS SOLUTIONS. Rakintzis, N. T. Translated by R. G. P. Towndrow (Atomic Energy Research Establishment, Harwell, Eng.), from Z. Phys. Chem. (Frankfurt), 57: 99-102(1968). 6p. Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 16608.

24221 (NYO–3242-30) FLUORESCENCE EXCITATION AND QUENCHING IN AQUEOUS SOLUTIONS OF SALICYLATE UNDER ULTRAVIOLET AND IONIZING RADIATION. Stein, Gabriel; Tomkiewicz, Micha (Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry). Mar. 1969. Contract AT(30-1)-3242. 162p. Dep. CFSTI.

Fluorescent light emitted from aqueous solutions of sodium salicylate under x irradiation originates from directly excited solute molecules. Excitation by energy transfer from solvent is absent in water. Therefore, processes in aqueous solutions are simpler than in organic ones. Fluorescence of the solute is quenched by radicals produced from the solvent by the radiation, enabling radical distribution to be studied at the nanoseconds level. Light emission was studied for 1×10^{-2} to 6×10^{-1} $\underline{M}$ solutions under x rays and up to 4 $\underline{M}$ under uv excitation. To interpret the results detailed comparison was made with quenching processes under uv. An NMR study of the structure in concentrated solutions was made to complete the interpretation. To coordinate results with those under ionizing radiations, existing models of the inhomogeneous distribution of radicals were critically surveyed and a one-radical model derived. This "expanding sphere" model gave the time dependence of radical concentration. The model was checked against and gave good agreement with data in the literature on the dependence of molecular yield on scavenger concentration. Using the new model and uv results, light emission under x rays could be accounted for in terms of radicals, inhomogeneously distributed in spurs, quenching the solute molecules excited by the radiation. Specific parameters are derived for processes under uv and x irradiation. (auth)

24222 (ORNL–4376) TRANSURANIUM PROCESSING PLANT SEMIANNUAL REPORT OF PRODUCTION, STATUS, AND PLANS FOR PERIOD ENDING JUNE 30, 1968. Burch, W. D.; Bigelow,

J. E.; King, L. J. (Oak Ridge National Lab., Tenn.). Apr. 1969. Contract W-7405-eng-26. 46p. Dep. CFSTI.

The status and the future production plans of the Transuranium Element Production Program at ORNL are summarized. The Transuranium Processing Plant (TRU) and the High Flux Isotope Reactor (HFIR) were built at ORNL to produce gram quantities of many of the transuranium elements, and milligram quantities of some of the transcalifornium isotopes. The total amounts of transuranium elements processed during the first two-year period are (approximately): 125 g of ^{242}Pu, 170 g of ^{243}Am, 300 g of ^{244}Cm, 1 mg of ^{249}Bk, 7 mg of ^{252}Cf, and 40 μg of ^{253}Es. Approximately 91 g of ^{242}Pu, 207 g of ^{243}Am, 239 g of ^{244}Cm, 25 μg of ^{249}Bk, and 1.7 mg of ^{252}Cf are still in various stages of purification in TRU. About 74 shipments were made, which totaled: 0.8 mg of ^{244}Pu, 37 g of ^{243}Am, 79 g of ^{244}Cm, 36 μg of ^{248}Cm, 411 μg of ^{249}Bk, 72 μg of ^{249}Cf (isotopically pure), 1 mg of ^{252}Cf, 1 μg of ^{253}Es (isotopically pure), and 16 μg of ^{253}Es containing some ^{254}Es and ^{255}Es. The production of about 5.5 mg of ^{249}Bk, 50 mg of ^{252}Cf, 260 μg of ^{253}Es, and 10^9 atoms of ^{257}Fm during the next eighteen months is anticipated. A total of about 1 g of californium is expected to be produced by about 1973. The current sequence of process steps is presented and the status of each step is summarized. The steps are as follows: (1) a feed solution is prepared by dissolving irradiated targets; (2) the plutonium is recovered using a batch solvent extraction process (Pubex); (3) the transplutonium elements are decontaminated from fission products by countercurrent solvent extraction (Tramex); (4) the americium and curium are separated from the transcurium elements by ion exchange; (5) the transcurium elements are separated from each other by chromatographic elution with α-hydroxyisobutyrate from a high-pressure ion exchange column; (6) the plutonium, americium, and curium are made into oxide microspheres, using a sol-gel technique; and (7) the microspheres are fabricated into HFIR targets, by remote means, for reirradiation to produce more transcurium elements. Sixteen TRU target rods developed longitudinal cracks in the cladding after irradiation in the HFIR for 125 to 175 days at a power level of 100 Mw. They were part of a group of 17 targets that had been irradiated for about one year in a Savannah River Plant reactor. A mathematical model, formulated to guide the development of an improved target design, indicates that a smaller loading of plutonium per target and/or pressing the pellets to lower densities will result in longer target lifetimes. Test targets are now being irradiated to confirm this. Three special californium targets were fabricated and irradiated to produce einsteinium and to refine some of the calculated values of cross sections in the chain of isotopes above californium. Aluminum tensile specimens were irradiated for use in studying the target failure problem. About 350 μg of ^{252}Cf was loaded into a small aluminum capsule for use as a source in fast-neutron activation studies. Uranium oxide ($^{236}U_3O_8$) was fabricated into pellets and irradiated in the HFIR hydraulic rabbit facility for production of ^{237}U. The rabbits were subsequently processed by personnel at the Los Alamos Scientific Laboratory, and the uranium was used in an underground nuclear event for measurement of the fission cross section of ^{237}U. Rabbits containing ^{253}Es were fabricated and irradiated in the HFIR to produce 39.3-hr ^{254m}Es for studies at the Argonne National Laboratory. The values used for transuranium element decay data and for cross-section data in planning irradiation-processing cycles, calculating production forecasts, and assaying products are tabulated in the Appendix. (auth)

24223 ELECTRON SPIN RESONANCE OF GAMMA-IRRADIATED SINGLE CRYSTAL OF CYTOSINE MONOHYDRATE AT 77°K. Herak, J. N.; Galogaza, V. (Inst. Rudjer Boskovic, Zagreb). J. Chem. Phys., 50: 3101-5(Apr. 1, 1969).

Single crystals of cytosine monohydrate were irradiated and analyzed with electron spin resonance spectroscopy at 77°K. Two types of radicals were observed and identified as the cytosine cation and anion radicals. The hyperfine splittings of the ^{14}N and ^{1}H nuclei for the cation radical are found to be in fairly good agreement with the predictions of the molecular orbital theory. The anion-radical hyperfine splittings could not be resolved in all crystal orientations. Both types of radicals rapidly disappear upon heating, probably via mutual recombination. (auth)

24224 RADICAL FORMATION IN X-IRRADIATED GLYCINE HCl. Box, Harold C.; Budzinski, Edwin E.; Freund, Harold G. (Roswell Park Memorial Inst., Buffalo). J. Chem. Phys., 50: 2880-4(Apr. 1, 1969).

Electron spin resonance spectroscopy was used to identify the electron and hole traps in single crystals of glycine HCl x irradiated at 4.2°K. Holes were trapped by the formation of Cl_2^- ions and electrons by the formation of

$Cl^-(NH_3)^+-CH_2-C(=O)(-O^-)$

Upon warming, the neutral radical CH_2-COOH was formed, which was identical with the radical produced in irradiated crystals of the free amino acid. The advantage of using the hydrochloride salt in this investigation is that the Cl_2^- ions are very stable and it is possible to observe unequivocally that the neutral radical is formed concomitantly with the decay of the glycine HCl negative ion. (auth)

24225 ESR SPECTRA OF ORIENTED POLYTETRAFLUOROETHYLENE SUBJECTED TO 20-nsec PULSES OF ELECTRONS. Lerner, N. R. (Lockheed Palo Alto Research Lab., Calif.). J. Chem. Phys., 50: 2902-10(Apr. 1, 1969).

Samples of oriented poly(tetrafluoroethylene) have been subjected to irradiation from a pulsed electron beam generator. The duration of the pulses was 20 nsec, and doses ranging from 0.8 to 14 Mrad were delivered to the samples. Working with oriented samples made it possible to distinguish and identify two distinct species in the samples irradiated in air. The relative concentration of the two species varied as a function of the dose. In samples receiving larger doses of radiation the species $-CF_2-(CF-O-O)-CF_2-$ dominated the ESR spectrum. At lower doses the species $-CF_2-O-O\cdot$ make a larger relative contribution to the ESR spectrum. Samples were also subjected to irradiation in vacuum. The ESR spectra obtained from the vacuum-irradiated samples before and after the admission of air is discussed. Samples were subjected (in air) to radiation from a ^{60}Co source, ranging from 5 to 30 Mrad, at a dose rate of 0.43 Mrad/hr. The species $-CF_2-O-O\cdot$ dominated the ESR spectrum of ^{60}Co irradiated samples. The details of the line shapes of the ESR spectra of samples irradiated in air are discussed. (auth)

24226 YIELDS OF EXCITED STATES IN THE PULSE RADIOLYSIS OF SOLUTIONS OF SUBSTITUTED ANTHRACENES. Kemp, T. J.; Roberts, J. P. (Univ. of Warwick, Coventry, Eng.). Trans. Faraday Soc., 65: 725-31(Mar. 1969).

A series of substituted anthracenes covering the complete range of photochemical fluorescence and triplet quantum yields, φ_F and φ_T, were examined in cyclohexane, benzene, and dioxane solutions by pulse radiolysis. Extinction coefficients were determined for triplet-triplet absorptions by means of Land's method, and these were used to obtain G-values for triplet states. Values for G (fluorescence) and hence G (total singlet) relative to a standard were also measured. G(triplet) was independent of φ_T for cyclohexane solutions, but was dependent on φ_T for benzene and dioxane. G (fluorescence) was approximately proportional to φ_F, which implies constancy of G (total singlet) for a given solvent. The mechanistic implications of these findings are discussed. (auth) (UK)

24227 RADIATION-PROCESSED WOOD-PLASTIC MATERIALS. Stein, Martin H.; Dietz, George R. (Nuclear Materials and Equipment Corp., Apollo, Pa. Atomic Energy Commission, Washington, D. C.). Mod. Mater., Advan. Develop. Appl., 6: 1-39(1968).

The properties of various combinations of wood-plastic materials are discussed. Other topics reviewed include: methods of preparation, working characteristics, product uses, marketing and economics, and potential uses. (J.G.B.)

24228 SEPARATION OF CARRIER-FREE ^{45}Ca FROM IRRADIATED SCANDIUM OXIDE. Yang, Mo Hsiung; Yeh, Si-jung (National Tsing Hua Univ., Hsinchu, Taiwan). Ho Tsu K'o Hsueh, 6: 91-6(Oct. 1968).

The use of the ^{45}Sc(n,p)^{45}Ca reaction for the production of carrier-free ^{45}Ca was investigated. Results show that highly pure scandium compounds must be used as target material. Most of the Sc and other impurities were removed by solvent extraction using TTA, and a trace quantity of ^{45}Ca was isolated from other radioactive impurities by cation exchange. The yield was about 1.6 mc per gram of scandium oxide if the target was irradiated for 180 hr at a neutron flux of 4×10^{13} n/cm^2 sec. (D.H.M.)

24229 PREPARATION OF ^{99}Mo. Cheng, Wen-pin; Yeh, Si-jung (National Tsing Hus Univ., Hsinchu, Taiwan). Ho Tsu H'o Hsueh, 6: 97-104(Oct. 1968).

In order to establish a ^{99}Mo/^{99m}Tc milking system, attempts were made to prepare radiochemically pure ^{99}Mo using the Tsing Hua Open-pool Reactor. Molybdenum trioxide was irradiated in the THOR and the ^{99}Mo was purified by solvent extraction, ion exchange, and alumina column chromatographic methods. It was found that the alumina chromatographic method is the most suitable process for obtaining pure ^{99}Mo. (auth)

24230 MORPHOLOGY OF POLYETHYLENE CRYSTALS AS POLYMERIZED BY γ-RADIATION. Toyota, Nobuhiro; Machi, Sueo (Japan Atomic Energy Research Inst., Takasaki). J. Polym. Sci., Part A-2, 7: 153-61(Jan. 1969).

The morphology of polyethylenes formed upon polymerization by γ-radiation below the melting point in various reaction media was investigated by using electron microscopy and scanning electron microscopy. When the polymerization was carried out in bulk at 30°C and in methanol, the polymer was fibrillar, and a small-angle x-ray scattering curve of the polymer did not indicate the existence of a long period. This suggests that the chains in the crystals have an extended conformation. When the polymerization was carried out in the presence of xylene at 30°C, platelet crystals having a folded structure were obtained. It was thus shown that the morphology of the growing polymer crystals is very much affected by the solubility of the polymer in the reaction medium. The effect of stirring during polymerization on the crystalline morphology was also studied. (auth)

24231 RADIATION DAMAGE TO ROENTGEN FILMS. Lundh, Arne (AB Ceaverken, Straengnaes, Sweden). Acta Radiol., Diagn., 7: 272-85(May 1968).

The role of natural or background radiation in fogging stored x-ray film was investigated. The increase in fog in relation to storing time is practically exclusively caused by exposure to radiation from building materials, added to background radiation from the earth. Storage premises and their surroundings should be of materials having a low radiation level. It is important that the films are stored at a reasonable radiation level, e.g., 10 to 15 μR/hr; at this level the monthly fog increase for a high-speed nonscreen film is 0.02 to 0.03. As the fog increase is directly proportional to the radiation sensitivity, this precaution is less important with low-speed industrial films. All other types of photographic silver halide materials are damaged in the same manner, insofar as they are highly sensitive to penetrating radiation. An increase of 2 to 3 times the background radiation causes a corresponding shortening of the effective life of films through an increase in the fog level. (BBB)

24232 SPECTRUM MODIFICATIONS CAUSED BY THE EFFECT OF RADIATION ON TRANSPARENT MATERIALS. Peyches, I. Verres Refract., 22: 261-7(May-June 1968). (In French).

Radiation effects on the appearance of color centers in transparent materials are considered. The various processes that can occur in crystals and glass submitted to radiation are reviewed on the basis of present knowledge of the structure of solids. (auth)

24233 GAMMA-RADIOLYSIS OF AQUEOUS BORIC ACID SOLUTION. Koike, Mitsuru (Japan Atomic Energy Research Inst., Tokyo); Tachikawa, Enzo; Matsui, Takao. J. Nucl. Sci. Technol. (Tokyo), 6: 163-9(Apr. 1969).

The γ-radiolysis of aqueous boric acid solutions of relatively high concentration was studied. Boric acid significantly promotes hydrogen formation up to 10^{-7} mol/ml but does not increase oxygen and hydrogen peroxide to any appreciable extent. Since boric acid reacts at a relatively slow rate with species formed by the primary process of water radiolysis, when an effective scavenger for e^-_{aq} (the precursor of H_2) such as NO_3^- is present, boric acid had no effects upon the total yield of H_2 in the range of concentrations studied. However, the yields of other products of the radiolysis (H_2O_2 and NO_2^-) are significantly reduced at high concentrations of boric acid when NO_3^- is present. These results are explained by established reaction schemes for the radiolysis of aqueous solution. On the basis of the behavior of NO_2^- from nitrate solutions, it is suggested that NO_2^- reacts with H_3BO_3 or H_2BO_3 radicals, the plausible reaction product from the reaction, $H_3BO_3 + OH \rightarrow H_2O + H_2BO_3$. (auth)

24234 THERMALLY PRODUCED F-AGGREGATE CENTERS IN DEUTERON-IRRADIATED NaF. Kikuchi, Akira (Ibaraki Univ., Hitachi, Japan). Ibaraki Daigaku Kogakubu Kenkyu Shuho, No. 16, 175-84(Dec. 1968).

Sodium fluoride crystals irradiated with deuterons at liquid nitrogen temperature, on warming to room temperature showed the evolution of absorption bands at 460, 570, 632, 870, and 1040 nm, which have the characteristic properties of three cluster F centers. The 460 nm band is ascribed to the one of specific F-aggregate centers. The 570 and 632 nm bands are attributed to the absorption by R_N centers. The 870 and 1040 nm bands are interpreted as being due to the R_1' and R_2' centers, respectively. Further annealing indicates that R_N bands are split into several components which have a pronounced vibrational structure at about 390°K and the higher complex aggregates such as R and N centers are formed. N bands in NaF crystals were tentatively assigned by zero-phonon optical absorptions. (NSA of Japan)

24235 EFFECTS OF RADICAL SCAVENGER AND WATER ON RADIOLYSIS REACTION VELOCITY OF C_{18} UNSATURATED FATTY ACIDS. Kitahara, Kazuta; Yoshinaga, Setsuyo (Kumamoto Univ., Japan). Radioisotopes (Tokyo), 18: 127-9(Apr. 1969).

The effects of radical scavengers, antioxidants, and water on the radiolysis reaction velocity of methyl oleate, methyl linoleate, and methyl linolenate were investigated. It was found that the presence of the radical scavengers or antioxidants suppressed radiolysis of unsaturated fatty acids; however, the presence of water accelerated the reaction. The velocity constant of the chemical reaction obtained from the ratio of the peak dimension of the gas chromatograms was the secondary reaction in the former and the primary reaction in the latter; in both cases the constant was found to be proportional to the square of the number of the double bonds in the unsaturated fatty acids. This phenomenon can be explained based on the dynamics of chemical reactions. (auth)

24236 ELECTRON SPIN RESONANCE AND OPTICAL STUDIES OF RADIATION-INDUCED TRAPPED ELECTRONS AND FREE-RADICAL INTERMEDIATES IN ORGANIC GLASSES. Lin, Jacob Wen-pin. Knoxville, Tenn., Univ. of Tennessee, 1968. 196p.

Thesis.

Trapped electrons were generated by either γ irradiation or uv photoionization, and studied by optical and ESR detection methods. Experiments were carried out to investigate the properties, to determine the radiation-chemical yield, $G(e^-)$, and to follow the thermal decay of the trapped electrons. The trapped electron in irradiated hydrocarbon glasses and hydrocarbon-amine mixtures exhibits a broad structureless absorption band in the near ir region with λ_{max} near 1600 mμ. It is also characterized by an ESR singlet signal at $g = 2.002$, having a width of about 4 gauss and easily saturated by microwave power. Photobleaching by ir light ($\lambda > 1$ μ) was observed to be a general effect for the trapped electron in these glasses. The radiolysis of 3-methylhexane and 3-methylpentane glasses at −196°C produced electrons in high yield, (viz., $G(e^-) = 0.87$ and 0.69, respectively). Semicrystalline hydrocarbons such as methylcyclopentane give a much lower yield (viz., $Ge(e^-) = 0.07$). Additions of concentrations of triethylamine (TEA) ≃ 5 mole % enhanced the $G(e^-)$ value for the hydrocarbons. The decrease of $G(e^-)$ at higher concentrations of TEA may be associated with increasing crystallinity. The results indicate that the magnitude of $G(e^-)$ is closely influenced by the polarity and the degree of disorder of the matrix. Studies of various compositions of hydrocarbon mixtures and hydrocarbon–amine mixtures suggest that the thermal stability of the trapped electron is affected by viscosity and polarity. In the photolysis of N,N,N′N′-tetramethyl-p-phenylenediamine in 3-methylpentane and other organic glasses at −196°C; a stationary-state concentration of trapped electrons is observed by ESR detection during photoionization. The decay of the trapped electron after photoionization was followed by both ESR and optical detection methods and is highly characteristic of the matrix. The results of these experiments provide direct evidence for the existence of a photodynamic equilibrium and suggest that the principal moving entity during thermal decay is the electron. A recombination mechanism involving a diffusive motion of trapped electrons in a rigid medium is suggested in order to rationalize the results on the thermal decay of trapped electrons. Radical ion and radical intermediates formed from α-methylstyrene and styrene by γ irradiation and photoionization were studied by ESR and optical detection methods. α-Methylstyrene captures an electron to form the corresponding radical anion in γ-irradiated 3-methylpentane and methyltetrahydrofuran glasses at −196°C and exhibits two absorption bands at 410 mμ (400 mμ in photoionized systems) and 595 mμ. The α-methylstyrene cation (λ_{max} = 475 mμ) was observed only in γ-irradiated 3-methylpentane glass containing α-methylstyrene at −196°C. The formation of this molecular cation is explained by positive hole migration. Warming of these irradiated glasses converts the radical anion to the neutral α,α-dimethylbenzyl radical (or α-methylbenzyl radical in the case of styrene) by proton transfer from the positive ion. If the matrix is changed to an ethanol glass, the latter radical is observed immediately after irradiation at −196°C. This radical exhibits an optical absorption band with λ_{max} at 322 mμ and the ESR spectrum can be interpreted by hyperfine splitting constants of 16.5 gauss for the 6 methyl protons, and 5.5 gauss for the 3 protons in the aromatic ring. Evidence from isotopic studies as well as the results of photoionization suggest that the neutral radical is formed in ethanol glasses by rapid proton transfer from the hydroxylic proton of the neutral ethanol molecule to the terminal C of the vinylidene group of the radical anion. The satisfactory correlation between the results of γ irradiation and photoionization confirms that molecular ionization is an important fundamental process in radiation chemistry. (Disser. Abstr.)

24237 INFLUENCE OF GAMMA-IRRADIATION ON THE THERMAL DECOMPOSITION OF THORIUM OXALATE DIHYDRATE. Mohanty, S. R.; Ray, M. N. (Utkal Univ., Bhubaneswar, India). Indian J. Chem., 7: 264-5(Mar. 1969).

The thermal decomposition of thorium oxalate dihydrate, unirradiated and irradiated with ^{60}Co γ-rays, was investigated at temperatures between 335 and 400°C. Irradiation enhanced the decomposition rate and diminished the energy of activation. (auth)

24238 ANNEALING BEHAVIOUR OF RECOIL ^{58}Co IN TRISACETYLACETONE Co(III) AFTER (γ,n) REACTION. Thomas, V. G. (Bhabha Atomic Research Centre, Bombay). Indian J. Chem., 7: 247-50(Mar. 1969).

A detailed investigation on the thermal annealing behavior of recoil Co-58 in trisacetylacetone Co(III) after the (γ,n) reaction is made. The results are compared with those reported for recoil Co-60 in the same complex after the (n,γ) reaction. The striking resemblance between the two, confirms the earlier view that the large disparity in the recoil energies of the two atoms may not alter their thermal annealing behaviour. (auth)

24239 THERMAL REACTIONS OF HYDROGEN ATOMS WITH ORGANIC COMPOUNDS IN SULFURIC ACID GLASSES AT LOW TEMPERATURE. Koehnlein, Wolfgang; Schulte-Frohlinde, Dietrich (Kernforschungszentrum, Karlsruhe, Ger.). Radiat. Res., 38: 173-85(Apr. 1969).

The formation (G-values) and the thermal disappearance of hydrogen atoms in sulfuric acid glasses were measured as a function of time and concentration of organic additives (isopropanol, ethanol, thymidine, and 5-bromodeoxyuridine). Thermal hydrogen atoms react with isopropanol and ethanol at 77°K by abstraction and with thymidine by addition. With 5-bromodeoxyuridine as additive, the production of at least two different radical species was found at low temperature. One radical is due to the reaction with thermal hydrogen atoms, whereas the other radical could result from the reaction with the (SO_4^-) radical. A "stepwise" disappearance of the hydrogen atoms at different isopropanol concentration was observed. (auth)

24240 PROCESS FOR PRODUCING POLYETHYLENE. (to Japan Atomic Energy Research Inst.). British Patent 1,147,727. Apr. 2, 1969. Priority date Nov. 25, 1966, Japan.

A process for the radioinduced polymerization of ethylene consists of irradiating the ethylene under a pressure of at least 5 kg/cm^2 with at least 10^3R/hr in a mixture with tertiary butyl alcohol present in 5 to 70 vol % of the volume of the reactor. Tertiary butyl alcohol, or its mixtures with water or CO_2, serves to promote the reaction, remove the reaction heat, and discharge the reaction products from the reactor. (B.L.M.)

24241 THE GAMMA RADIOLYTIC DECOMPOSITION OF CYSTEINE AND RELATED COMPOUNDS IN DILUTE, AQUEOUS SOLUTION. Peterson, Richard Merle. Newark, Del., Univ. of Delaware, 1968. 122p.

Thesis.

The radiation chemistry of the amino acid cysteine, was investigated in aqueous solution, primarily at pH 1 in air-free $HClO_4$. Qualitative and quantitative analyses by simultaneously polarography during radiolysis, various spectrophotometric methods, and chromatographic analyses involving isotopically labelled ^{14}C and ^{35}S cysteine showed that ^{60}Co γ irradiation at a dose-rate of approximately 6×10^{16} eV/g per minute decomposes cysteine primarily into cystine, H_2S, H_2, and alanine. A mechanism is postulated based on complete radical scavenging of the "primary" water radiolysis products. The mechanism of cysteine decomposition in solutions containing oxygen is not fully understood but appears to become involved in a chain reaction as the concentration of cysteine increases as indicated by the high observed G(-RSH) values. Radiolysis of related thiols, penicillamine, homocysteine, and 2-mercaptoethanol showed penicillamine to be different from cysteine radiolysis by the three-fold amount of H_2S yield produced, which might be due to the greater stability of the tertiary radical formed with penicillamine by reaction with H or OH. Investigations carried out at low cysteine concentration, 5×10^{-5} to 1×10^{-3}M with various treatments of the triply distilled water showed that there is a definite lowering of the cysteine radiolytic yield as its concentration is decreased, and this could be due to an impurity in the water which is an OH radical scavenger. These studies show that a primary mode of radiation protection afforded by cysteine to living tissue is by radical scavenging of water radiolysis radicals in nearly diffusion controlled reaction rates. (Disser. Abstr.)

24242 ELECTRON SPIN RESONANCE STUDIES OF IRRADIATED POLYTETRAFLUOROETHYLENE. Chen, Chun-fu. Nashville, Vanderbilt Univ., 1968. 93p.

Thesis.

Electron spin resonance (ESR) spectra of polytetrafluoroethylene (PTFE) x-irradiated in vacuum or in air were attributed to the propagating radical $S_3(-CF_2)$, the chain radical $2S_5(-CF_2-\dot{C}F-CF_2-)$, and a single broad line when irradiated in vacuum, or the peroxy radicals when irradiated in air. The alpha, beta, gamma hyperfine splitting of the double quintet are respectively 91, 32, and 3.5 Oe. Gamma-splitting is observed only when the sample is heated to 260°C for more than 30 min. The triplet spectrum becomes a well-resolved triple triplet at 160°C. The spectrum of peroxy radicals consists of an asymmetric singlet $O_I(-CF_2-CF\dot{O}O-CF_2-)$ and a symmetric singlet $O_{II}-CF_2-\dot{O}O-$). The S_3 and $2S_5$ radicals of PTFE x-irradiated in vacuum; and the O_I and O_{II} radicals of PTFE x-irradiated in air were separated. In addition, the effect of orientation and field dependence on free radicals $2S_5$, S_3, O_I, and O_{II} were investigated. The spectra of O_I and O_{II} radicals were found to be either symmetric or asymmetric depending on the orientation of the chain axis with respect to the magnetic field. S_3 radical becomes a well-resolved triple triplet when its chain axis is perpendicular to the magnetic field. (Disser. Abstr.)

24243 POLYMERIZATION AND COPOLYMERIZATION CHARACTERISTICS OF 1,2-DIMETHYL-5-VINYL PYRIDINIUM METHYL SULFATE. Monagle, Daniel Joseph. Newark, Del., Univ. of Delaware, 1968. 304p.

Thesis.

The copolymerization parameters of the very reactive monomer, 1,2-dimethyl-5-vinylpyridinium methyl sulfate, DMVPMS, which polymerizes and copolymerizes to yield water-soluble high-molecular-weight polyelectrolytes, were calculated by the method of nonlinear regression wherein the average mole fractional monomer compositions were employed together with the average copolymer compositions. This study showed that in the free-radical copolymerization of this ionic monomer, the dielectric nature of the solvent plays a significant role in its reactivity. This reactivity is discussed primarily in terms of a resonance factor, Q, and a polar factor, e, according to the method of Alfrey and Price. In water and in dimethyl sulfoxide, the pyridinium monomer is extremely reactive (Q = 17 and 57, e = 2.65 and 2.43 respectively). This reactivity is significantly decreased in aqueous methanol (Q = 3.3, e = 1.15). In glacial acetic acid, the pyridinium monomer behaves essentially the same as a substituted styrene (Q = 1.0, e = −.79). These results were rationalized in terms of the differences in the reactivity between the pyridinium ion, the ion-pair, and the undissociated pyridium methyl sulfate. These results were also correlated with the experiences of workers with other ionic monomers in terms of the proximity of charge to the radical site as well as in terms of solvent-solute interactions. Gamma-initiated polymerizations of 1,2-dimethyl-5-vinyl pyridinium methyl sulfate in aqueous solutions, in the presence and absence of salts indicate that low molecular weight (low viscosity) polymers are formed by a free radical mechanism that is first-order with respect to monomer concentration. No evidence was found to support an ionic mechanism for the spontaneous polymerization of this monomer in aqueous solution. Spontaneous copolymerizations of 1,2-dimethyl-5-vinylpyridinium methyl sulfate in the presence of CO_2 were not found to be inhibited and in fact the parameters calculated were essentially the same as those derived from persulfate initiation under N_2. (Disser. Abstr.)

24244 REACTION OF RECOIL SILICON WITH PHOSPHINE, SILANE, AND ETHYLENE. Eckelman, William Charles. St. Louis, Washington Univ., 1968. 86p.

Thesis.

Fast neutron irradiation of phosphine produced neutral ^{31}Si atoms whose chemically stable end-product was $^{31}SiH_4$. Phosphine–silane mixtures yielded $H_3{}^{31}SiSiH_3$ and $^{31}SiH_4$, the product ratio increasing rapidly with silane concentration until a plateau value of 4.78 ± 0.86 was reached at ca. 20% silane. The scavenging efficiency of silane suggested that a thermal species reacted in the product forming steps. The yield versus composition data were accommodated by a kinetic scheme in which a single species reacts with silane and phosphine to give $^{31}SiH_4$ and with silane to give $H_3{}^{31}SiSiH_3$. Two intermediates were considered: $^{31}SiH_2$ and $^{31}SiH_3$, and the latter discarded on the basis of inefficient scavenging by ethylene, nitric oxide, and tetrafluoromethane. The product spectrum from 1 : 1 phosphine–ethylene mixtures was consistent with the intervention of: $^{31}SiH_2$ rather than $^{31}SiH_3$. The major product was tentatively identified as $^{31}SiH_3CH_2CH_2PH_2$. The occurrence of a "hot" reaction preceding the product forming step was indicated by a large moderator effect on absolute yields of products from phosphine–silane mixtures. (Disser. Abstr.)

24245 A MASS-SPECTROMETRIC INVESTIGATION OF THE RADIOLYSIS OF METHANE BY REACTOR RADIATION. Scott, W. M.; Wilson, H. W. (Scottish Research Reactor Center, Glasgow). Org. Mass Spectrom., 1: 519-26(Aug. 1968).

An on-line mass spectrometric technique allowing study of radiation effects at short times was used to study the radiolysis of methane by reactor radiation. The experiments were carried out using the UTR 100 reactor at East Kilbride. Results using highly purified methane and methane with radical scavangers are de-

scribed. At 0.25% conversion of pure methane, G-values of 0.36, 0.24, 0.07, and 0.03 were calculated for C_3H_8, C_4H_{10}, C_5H_{12}, and C_6H_{14}, respectively. No pressure-dependent reactions were observed in the pressure range from 50 to 135 torr. The effects of radical scavengers were investigated. Irradiation of methane containing 1 to 2% ethylene gave G-values for C_2H_6, C_3H_8, n-C_4H_{10}, iso-C_4H_{10}, C_5H_{12} plus C_6H_{14}, C_2H_2, C_3H_6, C_4H_8, and C_5H_{10} of 1.33, 2.02, 2.03, 0.25, 0.34, 0.39, 0.37, 0.90, and 0.31. The effects of adding 1 to 2% propylene and 1 to 2% O_2 were also examined. Experiments with small quantities of O_2 emphasize the importance of removing all oxygen from the system before radiolysis. Processes involved in the radiolysis of methane are discussed. (BBB)

24246 ^{99m}Tc GENERATOR. Cheng, Wen-pin; Yeh, Si Jung (National Tsing Hua Univ., Taipai, Taiwan). J. Chin. Chem. Soc. (Taiwan), 15: 17-26(June 1968).

A systematic study was performed to develop a ^{99m}Tc generator for domestic use in nuclear medicine and biological tracer work by using ^{99}Mo produced by the Tsing Hua Open-pool Reactor (THOR). Alumina was used as generator bed and ^{99m}Tc was milked by physiologic saline solution. The optimum size of the alumina column to be used as the generator bed and the absorption capacity of alumina for Mo was determined. It was found that No. 1 alumina (a product of Bio Rad Lab) absorbed, on the average, 0.073 MoO_3/g of alumina. The generator bed was able to hold 2 g of the irradiated molybdenum trioxide if 30 g of No. 1 alumina was packed in the column. It was found that both dilute hydrochloric acid and sodium chloride solution can be used as eluting agent to milk ^{99m}Tc from the alumina column, but for medical and biological work it is more convenient to use physiologic saline solution. The alumina used in the generator bed is preconditioned with dilute nitric acid to keep it slightly acidic. Some of the typical elution curves obtained by milking under different conditions are shown. When No. 1 alumina was used as generator bed, a sharp elution curve was obtained, especially if the generator bed was washed with 50 ml of distilled water after ^{99}Mo has been loaded on the generator bed. Washing of the generator bed with distilled water after loading irradiated MoO_3 is very important to remove excess nitrate ion from the generator bed to raise the chemical purity of ^{99m}Tc solution eluted. A generator using No. 1 alumina for the generator bed gave an efficiency of the order of 40 to 55% for the first milking. Radioactivity concentrations of ^{99m}Tc obtained by the first milking were ~0.2 mCi/ml, and those of the second milking are ~0.1 mCi/ml, which fulfills the requirements specified by medical and biological workers. (BBB)

24247 ELECTRON SPIN RESONANCE STUDIES ON GAMMA-IRRADIATED FERROCENE. Saito, Eiichi (Brookhaven National Lab., Upton, N. Y. CEN, Saclay, France). J. Chem. Phys., 50: 3539-47(Apr. 15, 1969).

A study was made to determine the nature of the free radicals induced in ferrocene by ^{60}Co γ rays. The irradiations were carried out on the powder at 77°K, the temperature at which crystals have burst into powder form, and on the single crystals at 193°K. At 77°K two radicals are formed, I and II; I transforms itself into a third radical, III, on annealing at temperatures above 145°K. In the single crystals irradiated at 193°K, only radicals II and III are formed. When the single crystals were not too damaged, the disappearance of the radical III with concommitant appearance of a fourth radical, IV, which presents a hyperfine structure of five lines was observed. Taking into account the anisotropies of the g tensors, change in spectra upon deuterium substitution of the cyclopentadienyl protons, and behavior on annealing, the spectra of radicals I to IV were attributed tentatively as follows: I to a straight molecule-ferricinium ion, II to a protonated ferrocene radical, III to a bent molecule-ferricinium ion, IV to a C_5H_5–Fe–$C_4H_4^+$ radical. Mechanisms are given for the formation of these radicals as well as for their disappearance on annealing. (auth)

24248 STUDY OF THE PRODUCTS OF RADIATIVE GRAFT OF THE COPOLYMERIZATION OF CELLULOSE ACETATE AND POLYMETHACRYLIC ACID. Usmanov, Kh. U.; Mussaev, U. N.; Babaev, T. M.; Nazirov, B. (Tashkent State Univ.). Uzb. Khim. Zhr., No. 5, 62-5(1968). (In Russian).

The radiative grafting of acetyl cellulose and methacrylic acid was investigated in order to improve certain physical properties and to increase the hygroscopicity of the product. The molecular weight of the purified acetyl cellulose was 77, 600; it contained 53.6% of bound acetic acid. The inhibitor-free methacrylic acid was distilled at 60 to 63°C. The copolymer graft was synthesized in the presence of dimethylformamide. The acetyl cellulose was completely hydrolyzed, forming water-soluble compounds. The polymerization coefficient was determined from the viscosity of the polymethacrylic acid solutions in methanol. The results indicated that the formation of the copolymer graft is affected by the length of exposure, the dose rate, and the nature of the solvent. The irradiation tests were carried out at a dose rate of 150 R/sec. Under otherwise identical conditions, the copolymer yield was found to be higher in the presence of dimethylformamide than of acetone, although the polymerization coefficient was higher in the latter solvent. Increased exposure to radiation also increased the yield of the copolymer graft; the amount of the homopolymer decreased. Increase of the total dose also resulted in a reduction of the mean value of the branching. (TTT)

24249 KINETIC ANALYSIS OF THE REACTION OF HOT CHLORINE ATOMS WITH ALKANES; COLLISIONAL DISSOCIATION OF TRANSLATIONALLY EXCITED PRODUCTS. Spicer, Leonard; Wolfgang, Richard (Yale Univ., New Haven. Univ. of Colorado, Boulder). J. Chem. Phys., 50: 3466-76(Apr. 15, 1969).

The reactions with methane and ethane of hot chlorine atoms recoiling from the ^{40}Ar(γ,p)^{39}Cl nuclear reaction were studied. Displacement reactions, analogous to those of hot hydrogen with alkanes, were found. In the case of methane, these gave $CH_3{}^{39}Cl$ and $CH_2{}^{39}Cl$. Yields of these molecules show little pressure dependence, providing negative evidence for unimolecular decomposition due to internal excitation of primary products. A kinetic theory analysis of moderator data indicates that fast chlorine atoms are relatively less reactive than is hydrogen. Furthermore, energy transfer in inelastic collisions with methane appears to be relatively ineffective. The indicated weak coupling between translational and vibrational modes appears due to poor matching between the mean time of collision and the C–H bond vibration period. This study appears to provide the first definite evidence for collisional decomposition of hot molecules. $CH_3{}^{39}Cl$ as formed by reaction of ^{39}Cl and CH_4 must be translationally excited. A kinetic theory analysis shows that this hot molecule has a considerable probability of breaking up on striking argon atoms. The likelihood of decomposition on collision with methane is, as expected, much less. (auth)

24250 LIQUID PHASE OXIDATION RADIOLYSIS OF 1,4-DIOXANE. Galin-Vacherot, M. (Centre de Recherches sur les Macromolecules, Strasbourg). Bull. Soc. Chim. Fr., No. 3, 765-8(Mar. 1969). (In French).

The liquid phase oxidizing degradation of 1,4-dioxane was investigated analytically when γ-irradiated by ^{60}Co. The hydroperoxides formed are analyzed chemically. Formaldehyde, mono-, and di-formates of ethylene glycol, ethylene glycol, and glycol aldehyde ether were identified and determined by gas chromatography and infrared spectrometry. The entire data cannot be interpreted without superposing several oxidation and degradation mechanisms. (auth)

24251 OXYGEN TRANSFORMATION BY BETATRON IRRADIATION. Stromme, A. (Central Hospital, Karlstad, Sweden). Phys. Med. Biol., 14: 323-5(Apr. 1969).

Several elements of which the human body is composed were subjected to betatron irradiation, in connection with studies on activity induced in patients undergoing radiotherapy with high energy radiation. After irradiation of oxygen compounds ^{15}O and ^{14}O were easily identified. There was also evidence of one or more nuclides with longer half-lives. In order to investigate the latter finding further, distilled water, H_3BO_3 and Al_2O_3 were irradiated; reasons for choosing these compounds are given. Irradiation doses varied from 200 R to 80 kR. The only γ rays detected with a counting time up to several hours were the 511 keV annihilation radiation and the 2.3 MeV γ rays from ^{14}O. When the counting was continued for a sufficiently long time, however, the decay curve always indicated a nuclide of half-life 20.5 ± 0.2 min., which was undoubtedly ^{11}C, while the first part of the curve was dominated by ^{15}O and ^{14}O. If the existence of a fourth nuclide ^{13}N with half-life 10 min is postulated, it would fit well with the observed decay curves. Nuclear reactions to produce the four nuclides are suggested and discussed. Tritium from a ^{16}O(γ,^{3}H)^{13}N reaction was not detectable. (UK)

24252 COMMENTS ON THE PAPER "SCATTERING EFFECTS IN ION BEAM EXPOSURE OF PHOTORESIST POLYMER FILMS." Holland, L. (Edwards High Vacuum International Ltd., Crawley, Eng.). J. Phys., D (London), 2: 767(May 1969).

Polymer films may grow on ion-bombarded surfaces due to cross-linking of hydrocarbon molecules adsorbed from a vacuum atmosphere. Electron-induced polymer formation has been studied intensively, but only limited information exists on the role of ions in promoting the growth of similar films. Attention is drawn to a recent paper (loc. cit. 1: 1657-65(1968)), and it is suggested that polymer growth during argon ion bombardment may have arisen also from secondary electrons returned to the target. (auth)(UK)

24253 THE SURFACE CHEMISTRY OF CARBON; STUDIES ON THE USE OF CARBON AS AN ADSORBENT IN NUCLEAR REACTORS OF THE AQUEOUS SUSPENSION TYPE. van der Plas, Theo. Delft, Netherlands, Technische Hogeschool, 1968. 279p. Thesis.

Studies on the use of carbon as an adsorbent in nuclear reactors of the aqueous suspension type are presented that include general background (principle of aqueous suspension nuclear reactor and problems related to the use of carbon blacks); the adsorption of fission products (experimental procedure and adsorption of Eu(III) ion on quartz and carbon); surface chemistry of carbon (survey of literature, titration curves of carbon, methods of determination of functional groups, pore sizes and densities, pore sizes and chemical reactions); and radiation chemistry of aqueous carbon black suspensions (radiation chemistry of water and aqueous solution, description of irradiation facilities, preparation of samples and methods of analysis, results of irradiation in Y-3, results of static irradiation). (D.H.M.)

24254 APPROXIMATE SOLUTIONS TO THE DIFFUSION–KINETIC EQUATIONS. Haskin, F. E.; Faw, R. E. (Kansas State Univ., Manhattan). Nucl. Appl., 6: 452-65(May 1969).

The partial differential diffusion–kinetic equations describing the diffusion and reaction of chemically active species along the tracks of ionizing radiation are discussed. The few limiting cases of these equations that possess exact analytic solutions form the basis for a general expansion of the probability densities of reactive species in terms of time dependent Gaussian distribution functions. In this expansion the familar prescribed diffusion hypothesis of Samuel and Magee appears as the first order approximation. The convergence of the expansion technique and its applicability to multi-radical reaction mechanisms are illustrated by means of example calculations. One of the chief advantages of the method introduced is that it allows the work of Ganguly and Magee on overlapping spherical spurs to be extended to multi-radical models. (auth)

24255 THE PREPARATION OF MULTIGRAM QUANTITIES OF ^{242}Cr FOR SNAP-11. Vaughen, V. C. A.; McDuffee, W. T.; Lamb, E.; Robinson, R. A. (Oak Ridge National Lab., Tenn.). Nucl. Appl., 6: 549-58(June 1969).

SNAP-11 is an isotope-fueled thermoelectric generator, fueled with 7.5 g of ^{242}Cm, which was obtained from ^{241}Am irradiated to $\sim 1.2 \times 10^{21}$ n cm^{-2}. The irradiated material was dissolved in hydrochloric acid 15 to 30 days after discharge from the reactor and processed through two cycles of solvent extraction to remove ionic and radioactive contaminants. The curium and americium were converted to the sesquioxide, pelletized, and encapsulated into the isotopic heat source. The heat source was installed in a thermoelectric converter package to complete the SNAP-11 system, which was then tested for 90 days in a lunar environment simulator at a pressure of 10^{-7} torr and temperatures from –235 to +235°F. It successfully met all performance specifications. (auth)

24256 KINETICS OF IONIC AND FREE RADICAL CHAIN REACTIONS IN RADIATION CHEMISTRY. Martin, Donald H.; Taylor, Robert B.; Williams, Ffrancon (Univ. of Tennessee, Knoxville). Nucl. Appl., 6: 466-73(May 1969).

A general kinetic treatment applicable to ionic and free radical reactions in the radiation chemistry of liquids is presented. From the simple theory of homogeneous kinetics, suitable expressions were derived for the concentrations and lifetimes of ions and free radicals in the steady state. The problem of geminate recombination of ions is also discussed. For chain reactions, the predominant contribution to the kinetic chain length comes from the participation of free ions and free radicals undergoing bimolecular recombination. The problem encountered in many studies of radioinduced chain reactions is to achieve the limiting rates of propagation that apply only in the absence of chain termination by impurities or products of the radiolysis. This problem is discussed in connection with the free radical isomerization of 1-bromobutane and the ionic polymerization of isobutylene. Through the use of stringent drying conditions, $\underline{G}$ (–m) values as high as 10^8 were obtained in the latter case. The kinetic data can be used to calculate the propagation rate constant for the cationic polymerization of isobutylene. It is possible to predict the maximum rates and $\underline{G}$ values, which are obtainable as a function of dose rate in the temperature range over which these reactions were studied. (auth)

24257 CONTINUOUS PRODUCTION OF GRAFT COPOLYMERS OF STARCH WITH ACRYLAMIDE AND ACRYLIC ACID BY ELECTRON PREIRRADIATION. Reyes, Zoila (Stanford Research Inst., Menlo Park, Calif.); Clark, Carroll F.; Comas, Marie; Russell, C. R.; Rist, C. E. Nucl. Appl., 6: 509-17(May 1969).

The development of practical processes, involving electron preirradiation, for large-scale production of graft copolymers of starch with acrylamide (AA) and acrylic acid (AAc) was studied. In the pilot plant built to explore the continuous production of AA- and AAc-starch grafts, starch was fed continuously to a vibrating trough, which transported the starch as a thin layer under the beam of a 1-MeV resonant transformer. The irradiated starch then fell into a tank where it reacted with a solution of either AA or AAc being fed simultaneously to the tank reactor. Large samples of AA- and AAc-starch grafts were prepared at various grafting levels, and their physical and chemical properties were determined. Process flow sheets were prepared, and preliminary investment and production cost estimates were made for plants capable of producing 5 million pounds annually. (auth)

24258 ^{238}Pu FOR BIOMEDICAL APPLICATIONS. Mullins, L. J.; Leary, J. A. (Los Alamos Scientific Lab., N. Mex.). Nucl. Appl., 6: 287-97(Apr. 1969).

^{238}Pu metal (80 atom % ^{238}Pu) of high chemical purity was prepared and characterized. An electrorefining process was developed to prepare the metal on a 1-cm^3 scale. The neutron emission rate of three lots of electrorefined metal was 2446 (±30) n/sec per gram Pu. Correcting this measured rate for chemical impurities and fast fission gives a spontaneous fission rate of 2234 n/sec per gram Pu, or 2800 n/sec per gram of ^{238}Pu. Neutron and gamma dose rates were also measured. ^{238}Pu-Ga alloy, $^{238}PuO_2$, and ^{238}PuN were prepared and evaluated as radioisotopic heat sources. (auth)

24259 A PRELIMINARY STUDY OF THE EXPOSURE OF N_2–O_2–SO_2 MIXTURES TO IONIZING RADIATION. Liuti, G.; Dondes, S.; Harteck, P. (Rensselaer Polytechnic Inst., Troy, N. Y.). Nucl. Appl., 6: 494-8(May 1969).

Irradiation of N_2–O_2–SO_2 mixtures at pressures between 10 and 30 atm produced a white solid product of approximate formula $(NO_2)_2S_2O_{10}$. When the SO_2 was quantitatively consumed in the presence of an excess of N_2 and O_2, only NO_2 and N_2O were found in the gas phase as products. The G-value for nitrogen fixation (in the condensed and gas phases) was not large and seldom exceeded unity. (auth)

24260 CHEMONUCLEAR AND RADIATION CHEMICAL PROCESS APPLICATIONS. Steinberg, Meyer (Brookhaven National Lab., Upton, N. Y.). Nucl. Appl., 6: 425-33(May 1969).

Existing and potential applications of high-energy radiation from fission fragment, isotopic, and machine radiation sources for commercial chemical processing purposes are reviewed. Fission fragment chemonuclear processes have potential for endothermic chemical systems. The synthesis of ozone from oxygen or air by a chemonuclear process is an especially attractive possibility for use in water purification schemes. Improving radiation chemical yields (G-values) and demonstration of a contamination-free product are necessary. Several chemical processes using ^{60}Co gamma and electron accelerator radiation have reached commercial status. These include the hydrobromination of ethylene, the production of wood–plastic combinations, and the modification of polymers for obtaining a variety of specific plastic properties. New possibilities for applications development include the radiation induced polymerization of monomers, grafting of monomers, product sterilization, production of concrete-polymer composites, and catalytic effects on electrode reactions. (auth)

24261 A MICRO VOLUME ELECTROLYSIS CELL FOR RAPID ELECTRODEPOSITION OF RADIOACTIVE NUCLIDES. Berlandi, Francis J.; Mark, Harry B. Jr. (Univ. of Michigan, Ann Arbor). Nucl. Appl., 6: 409-11(Apr. 1969).

A micro volume electrolytic cell designed specifically for selective electrodeposition of radioactive isotopes from solution uses electrolytic solution volumes from 5 to 250 microliters. As electrolysis times are short (10 to 4000 sec), short-lived isotopes can be deposited as uniform films for further study. (auth)

24262 ELECTRON BEAM IRRADIATION OF POWDERED MATERIALS. Wilkinson, Bruce W.; Clifford, Wayne H. (Michigan State Univ., East Lansing). Nucl. Appl., 6: 499-508(May 1969).

In the irradiation of powders it is desirable to utilize completely the radiation beam while assuring a uniform irradiation of the product. When an electron beam is the radiation source, this is usually done by spreading the particles on a conveyor belt with a carefully controlled thickness of product. Non-uniform product thickness and depth-dose variations of the beam make the desired goals difficult to achieve. A study in which the particulate material (methyl cellulose) was maintained in a fluidized state while the electron beam was injected into the bed is reported. Complete utilization of the beam striking the bed was thus achieved and the

product was shown to have been irradiated uniformly. The fluidized bed was operated under both batch and continuous feed conditions. In addition, it was observed that a comparable degradation of the methyl cellulose required only about half the radiation exposure needed with thin layer processing. Factors that may be responsible for this effect are discussed. (auth)

24263 RADIOLYSIS OF CARBON TETRAFLUORIDE BY ^{60}Co GAMMA PHOTONS OR BY RECOILING FISSION FRAGMENTS. Gurley, Richard N.; Wethington, John A. Jr. (Univ. of Florida, Gainesville). Nucl. Appl., 6: 483-93(May 1969).

The radiolysis of CF_4, alone and mixed with UF_6, $UF_6 + N_2$, $UF_6 + Ar$, $UF_6 + Xe$, $UF_6 + SF_6$, and $UF_4 + C$ by gamma photons from ^{60}Co or by fission fragments from ^{235}U gave C_2F_4 as the principal product. Traces of C_2F_6O and C_3F_6O were also found. In the γ irradiation of $CF_4 + UF_4 + C$, charcoal acted as a fluorine scavenger and increased the consumption of CF_4, but N_2, Ar, Xe, and SF_6 showed no measurable scavenging effects. During the fission fragment irradiations, C, N_2, and Xe acted as scavengers, but such action by Ar or SF_6 was not detected. The results for ^{60}Co γ irradiations and for fission fragment irradiations could be explained by a dynamic interconversion between CF_4 and the products C_2F_4 and F_2. A mathematical model that related the extent of interconversion with energy deposition was formulated. (auth)

24264 RADIATION GRAFT COPOLYMERIZATION OF SILICONES ONTO TEXTILE. Meshitsuka, Gisuke; Shimizu, Harumichi (Tokyo Metropolitan Isotope Research Center). Kobunshi, 17: 922-7(Oct. 1968). (In Japanese).

The radiation graft copolymerization of silicones to cotton and various other textiles was investigated with the purpose of giving the textiles permanent water-repellency. The results of the investigation on the graft reactions, the permanent water-repellency, and the mechanical properties of the grafted textiles are reported. Good water-repellency was given to nearly all the grafted textiles at 1 to 2% of the degree of grafting and the permanency of the water repellency in dry-cleaning or abrasion was excellent. The changes of the mechanical properties for each textile were different, but in general the bending and abrasion resistances of the cellulose textiles increased and their tensile strength decreased. (NSA of Japan)

24265 RADIATION-INDUCED GRAFT COPOLYMERIZATION OF BUTADIENE TO POLYETHYLENE BY TRAPPED RADICALS. Furuhashi, Akira; Mukozaka, Hiroshi. Denki Tsushin Kenkyusho Kenkyu Jitsuyoka Hokoku, 17: 1673-81(Aug. 1968). (In Japanese).

Low temperature graft copolymerization of butadiene by trapped radicals in irradiated polyethylene (PE) was studied in air and in vacuo. Grafting yield curves of the trapped radical type were obtained in both cases, and the apparent activation energies from 15 to 50°C were 9.7 Kcal/mol for PE of the density of 0.947 and 8.4 Kcal/mol for PE of the density of 0.916. The degree of grafting was proportional to one-half power of the dose rate. The restrictive effect against grafting by oxygen is almost negligible below 15°C but the influence of oxygen on the degree of grafting when left in air appeared more eminently in the thinner film and in the PE of lower density. From the results, it was considered that the low temperature graft copolymerization of the preirradiated PE in air was initiated by the trapped radicals (oxygen and unreacted allyl radicals) in the PE. (NSA of Japan)

24266 PRODUCTION OF BROMITE AND PERBROMATE IONS IN CRYSTALLINE $CsBrO_3$ IRRADIATED WITH ^{60}Co γ RAYS AND THE VIBRATIONAL SPECTRUM OF THE BrO_4^- ION. Brown, L. C.; Begun, G. M.; Boyd, G. E. (Oak Ridge National Lab., Tenn.). J. Amer. Chem. Soc., 91: 2250-4(Apr. 23, 1969).

The formation at ca. 30°C by ^{60}Co γ rays of perbromate and bromite ions in $CsBrO_3$ was demonstrated by infrared absorption measurements on irradiated crystals and by ion exchange column chromatographic separations on aqueous solutions of the radiolyzed solid. Vibrational spectra (ir and laser-excited Raman measurements) were obtained for BrO_4^- ion in solution and in crystalline $RbBrO_4$ and $(C_6H_5)_4AsBrO_4$. The frequency assignments are ν_1 801, ν_2 331, ν_3 878, and ν_4 410 cm^{-1}. Force constants derived from these frequencies suggest that there is a close similarity in bonding between BrO_4^- and IO_4^- and that a significant decrease in the nonbonding interactions occurs in the series ClO_4^-, BrO_4^-, IO_4^- as the size of the central atom increases and the oxygens become less crowded. An unsuccessful search was made for $^{82}BrO_4^-$ ion formed in $^7LiBrO_3$ by thermal neutron capture. The yield of $^{82}BrO_4^-$ ion, if formed, was less than 0.05%. (auth)

24267 PULSE RADIOLYSIS STUDIES. XV. REACTIVITY OF THE OXIDE RADICAL ION AND ON THE OZONIDE ION IN AQUEOUS SOLUTION. Gall, Bonnie L.; Dorfman, Leon M. (Ohio State Univ., Columbus). J. Amer. Chem. Soc., 91: 2199-2204(Apr. 23, 1969).

The reactivity of the oxide radical ion, O^-, and the decay kinetics of the ozonide ion, O_3^-, were investigated in aqueous solutions at pH > 13, containing methanol, ethanol, or benzoate ion, by the pulse radiolysis method. The decay of O_3^- occurs through the thermal dissociation reaction, $O_3^- = O_2 + O^-$, for which the absolute rate constant at 25°C is $(3.3 \pm 0.3) \times 10^3$ sec^{-1}, and the activation energy is 11 ± 2 kcal/mole. The reactive species in the over-all decay of ozonide is O^-, which is in equilibrium with OH, and which reacts with additives such as methanol and ethanol. Absolute rate constants for these reactions are: $(5.2 \pm 1.0) \times 10^8$ M^{-1} sec^{-1} for $O^- + CH_3OH$ and $(8.4 \pm 1.6) \times 10^8$ M^{-1} sec^{-1} for $O^- + C_2H_5OH$. The reactivity of O^- with benzoate ion is at least three orders of magnitude lower than that of OH. The reactivity of O^- in several types of reactions is compared with that of OH, the normal form of the hydroxyl radical. (auth)

24268 RADICAL PRECURSORS OF ACETALDEHYDE IN THE RADIOLYSIS OF ETHANOL. Ackerman, L. G. J.; Basson, R. A. (Atomic Energy Board, Pretoria). J. S. Afr. Chem. Inst., 21: 187-9(1968).

The mechanism of formation of acetaldehyde in the radiolysis of pure de-aerated ethanol is still controversial. The nature of the acetaldehyde yield in ethanol was studied using ferric chloride as a scavenger for α-hydroxyethyl radicals. Ferric chloride concentration was varied from 10^{-6}M to 10^{-2}M, and was found to increase the aldehyde yield from 3.2 to a plateau value of 8.0. The results could not be explained in terms of dimerization (a mechanism proposed earlier in the case of methanol radiolysis) as the sole fate of α-hydroxyethyl radicals in pure ethanol. Thus the increase in the aldehyde yield (4.8) is significantly greater than twice the decrease in the glycol yield (3.3). A similar situation was also found in the case of n-propanol. This suggests that disproportionation of α-hydroxyethyl radicals may also take place. The importance of this reaction is assessed on the basis of a reaction scheme which is outlined. (BBB)

24269 RADIOINDUCED PARAMAGNETIC CENTERS IN ANTHRACENE AND DEUTERATED ANTHRACENE. Simpson, G. A.; Castellanos, J.; Cobas, A.; Weisz, S. Z. (Puerto Rico Nuclear Center, San Juan). Mol. Cryst., 5: 165-70(Oct. 1968).

A model of a physical defect produced in anthracene was recently proposed based on the interpretation of the 4-line EPR spectra, intensity distribution 1 : 3 : 3 : 1, as associated with a radioinduced, annealable defect in crystalline anthracene as resulting from the hyperfine interaction of 3 equivalent protons on a linear segment of a dimeric anthracene radical. If such a species is produced, then it was anticipated that the paramagnetic center produced on irradiation of deuterated anthracene will have a considerably narrower 7-line structure with intensity distribution of 1 : 3 : 6 : 7 : 6 : 3 : 1. Results reported here on polycrystalline deuterated anthracene are consistent with the previous interpretation. EPR studies of ^{60}Co γ-induced damage in anthracene ($C_{14}H_{10}$) and deuterated anthracene ($C_{14}D_{10}$) powders were made up to a dose of 7×10^8 rad. Interpretation of the spectra is consistent with that resulting from the hyperfine interaction of three equivalent protons. Excessive breadth of the spectrum of the radical produced in $C_{14}D_{10}$ is attributed to a high concentration of incompletely deuterated radical resulting from the presence of $C_{14}D_9H$. (BBB)

Radiochemistry

Refer also to abstract 24214.

24270 BEAM STUDIES OF THE ENERGY DEPENDENCE OF HOT-HYDROGEN-ATOM REACTIONS WITH CYCLOHEXANE. Menzinger, Michael; Wolfgang, Richard (Univ. of Colorado, Boulder. Yale Univ., New Haven). J. Chem. Phys., 50: 2991-3004(Apr. 1, 1969).

Beam studies of the energy dependence of hydrogen-atom–molecule reactions having appreciable thresholds are reported. Such investigations spanning the entire chemical range promise to be of importance in understanding the dynamics of reactive collisions. The interactions with solid cyclohexane of tritium ion beams, both T^+ and T_2^+, having controlled energy between 1 to 200 eV were examined. These ions undergo efficient charge transfer at the surface of the target to form hot tritium atoms of similar velocity. Labeled products are formed by hot-atom reactions, and their yields are measured by radio-gas chromatography. At high energies (≥30 eV), absolute yields for T^+ beams are close to those found by the nuclear recoil technique. With T_2^+, high-energy yields are about 20% lower; this apparently corresponding

to the fraction of ions forming unreactive T_2 upon charge exchange. At lower energies, yields decline. The threshold for the T for H replacement is at 1.5 ± 0.5 eV. Hexenes and hexanes appear to result from processes in which a C–C as well as a C–H bond is ruptured. The threshold for such double displacement is at 4.5 ± 0.5 eV. Provided certain rather drastic assumptions are made, the energy dependence of the yields can be used to derive approximate excitation functions. (auth)

Separation Processes

Refer also to abstracts 24068, 24073, 24077, 24103, 24117, 24144, 24214, 24222, 24229, 24427, 24857, 25899, and 26018.

24271 (ANL-7546) SEPARATION OF MICROGRAM QUANTITIES OF ^{252}Cf AND ^{248}Cm BY EXTRACTION CHROMATOGRAPHY IN A HIGH-LEVEL CAVE. Horwitz, E. P.; Bloomquist, C. A. A.; Buzzell, J. A.; Harvey, H. W. (Argonne National Lab., Ill.). Feb. 1969. Contract W-31-109-eng-38. 16p. Dep. CFSTI.

The extraction chromatography technique was applied to the separation of microgram quantities of ^{248}Cm from hundred-microgram quantities of ^{252}Cf. The bis(2-ethylhexyl)ester of orthophosphoric acid adsorbed on hydrophobic Celite was used as the column material. Dilute nitric and hydrochloric acids were used as the elutriants. Column runs were performed in a high-level cave with 48-in. concrete shielding. Decontamination factors of ^{252}Cf from the ^{248}Cm of 10^8-10^9 were obtained in a single-column run. (auth)

24272 (CEA-CONF-1267) EFFECT OF THE ORGANIC DILUENT ON TLA EXTRACTION OF Pu(IV) FROM NITRIC ACID MEDIUM. Koehly, G.; Berger, R. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [1967]. 12p. (CONF-680912-3). Dep.

From 11th International Conference on Coordination Chemistry, Haifa and Jerusalem, Israel.

The effects of various diluents on the extraction of Pu^{4+} by tridodecylammonium and methyltridodecylammonium nitrates were investigated. The Pu^{4+} distribution coefficients between the tertiary or quaternary ammonium salts and nitric acid solutions were measured by alpha counting. (M.C.G.)

24273 (CEA-R-3514) INFLUENCE OF DIFFUSION ON EXTRACTION KINETICS IN POROUS BODIES. THE CASE OF URANIUM OXIDES. Tinturier, Bernard (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires). 1968. 104p. (In French). Dep.

Thesis. Submitted to Paris Univ., France.

The study of the leaching of uranium ore can be considered theoretically as the problem of the diffusion of liquids in porous bodies and in particular as that of its influence on the chemical reaction rates of conventional uranium oxides. Below a certain value of the pore diameter, it is diffusion that is responsible for mass transfer. The porous structure can be characterized by various physical constants, which modify the free diffusion equation, and, as long as the pores have a diameter greater than a few microns, it can be shown that the pore walls have a negligible effect on the diffusion. The diffusion coefficients for uranium nitrate, sulfate, chloride, acetate, and perchlorate were determined. In the case of the reaction of uranium trioxide with acids in a porous body, the reaction kinetics are governed by the arrival of the reagent by diffusion. The attack of uranium dioxide by an acidic ferric solution was studied under the same conditions and it was found that diffusion modifies the influence of the ferrous and ferric ion concentrations on the reaction kinetics. The same is true for the oxide U_3O_8. All the results concerning these reactions studied in the absence of the influence of diffusion should be modified to take this factor into account when it intervenes in an extraction process. (auth)

24274 (DOCKET-50332-4) BARNWELL NUCLEAR FUEL PLANT. Safety Analysis Report, Amendment 2. (Allied Chemical Nuclear Products, Inc., Florham Park, N. J.). Mar. 21, 1969. 325p. Dep. CFSTI.

A request for authorization of irradiated fuel recovery at the Barnwell Nuclear Fuel Plant is recorded. Information supporting this request is given under the following broad headings: introduction, general considerations, design criteria, process systems, auxiliary systems, confinement systems, radiological protection, management systems, pre-operational testing, site description, safety analysis, and technical specifications. The plant will process UO_2 or PuO_2-UO_2 fuel elements clad with stainless steel or zirconium alloys using a chop-leach head-end with semicontinuous dissolution of the oxide core to form a feed for TBP extraction. The plant will have the capability of recovering neptunium. A financial report by the Allied Chemical Corporation for 1968 is included. (M.C.G.)

24275 (K-L-6213) SEMIWORKS FLUID-BED STUDIES OF VOLATILITY PROCESS FOR ZIRCALOY-CLAD URANIUM DIOXIDE POWER REACTOR FUELS. Monk, T. H.; Pashley, J. H.; Schappel, R. B. (Oak Ridge Gaseous Diffusion Plant, Tenn.). [1967]. Contract W-7405-eng-26. 39p. (CONF-690307-2). Dep. CFSTI.

From Advances in High-Pressure Technology Symposium, New Orleans, La.

The volatility process for Zircaloy-clad pelletized UO_2 consists of four steps: chemical decladding, oxidation of the pellets, selective fluorination of uranium with BrF_5, and plutonium recovery by reaction with elemental fluorine. Semiworks studies were carried out in a 54-test series with two basic groupings of the tests. The first group involved only oxidation of UO_2 pellets. Chemical decladding, followed by pellet oxidation without a subsequent fluorination step, was investigated in the second experimental set. (M.C.G.)

24276 (LA-3542) PLUTONIUM PROCESSING AT THE LOS ALAMOS SCIENTIFIC LABORATORY. Christensen, Eldon L.; Maraman, William J. (Los Alamos Scientific Lab., N. Mex.). Feb. 1968. Contract W-7405-eng-36. 85p. Dep. CFSTI.

Plutonium-bearing residues created in the many research and development programs at the Los Alamos Scientific Laboratory are extremely varied in type of contaminant as well as in the nature of residue. The recovery and purification of the plutonium in these residues requires, therefore, the use of a number of processes. The equipment and procedures for plutonium recovery ranging from the ether extraction and acetate precipitation used in 1943 to the anion-exchange systems now used are described. (auth)

24277 (ORNL-4383) THE USE OF FERROUS NITRATE AS A PLUTONIUM REDUCTANT FOR PARTITIONING PLUTONIUM AND URANIUM IN PUREX PROCESSES. Horner, D. E. (Oak Ridge National Lab., Tenn.). Apr. 1969. Contract W-7405-eng-26. 17p. Dep. CFSTI.

Laboratory-scale studies showed ferrous nitrate–hydrazine solutions to be an attractive alternative to ferrous sulfamate solutions for partitioning plutonium and uranium in a Purex flowsheet. In batch countercurrent tests simulating the processing of fast reactor fuels, more than 99.9% of the plutonium was stripped from the solvent by using as little as 25% of the stoichiometric amount of Fe(II) needed to reduce all of the plutonium. Replacement of the ferrous sulfamate eliminates sulfate (its ultimate decomposition product) from the system, thereby simplifying subsequent processing and waste disposal. (auth)

24278 (UJV-2119-Ch) METHOD FOR STRONTIUM RECOVERY FROM WATER WASTE. Konecny, C. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Jan. 1969. 72p. (In Czech). Dep.

A review is presented on methods for the recovery of Sr from aqueous solutions. These methods include: precipitation, ion exchange, solvent extraction, and foam separation. 569 references are given to published literature for the period 1949 to June 1967. (P.C.H.)

24279 SEPARATION OF METAL IONS ON TIN(IV) TUNGSTATE AND SELENITE PAPERS. Qureshi, Moshin; Mathur, K. N.; Israili, A. H. (Aligarh Muslim Univ., India). Talanta, 16: 503-9 (Apr. 1969).

Papers impregnated with the inorganic ion exchangers tin(IV) tungstate and selenite were shown to be useful for ion exchange chromatography of several metal ion mixtures (including Be^{2+}, Sr^{2+}, rare earths, Zr^{4+}, Cs^{+}, Ba^{2+}, Hf^{4+}, and UO_2^{2+}) and suitable solvent systems were developed and evaluated. (auth) (UK)

24280 CATION EXCHANGE SEPARATION OF SCANDIUM FROM RARE EARTHS IN OXALIC ACID MEDIA. Orlandini, K. A. (Argonne National Lab., Ill.). Inorg. Nucl. Chem. Lett., 5: 325-31 (Apr. 1969).

A method is described based on the elution of Sc as an oxalate complex from a cation exchange column (Dowex 50) that, under the same conditions, strongly retains the rare earths and yttrium. The separation factor is > 800, and high flow rates (up to 10 ml/min) may be used with small resin columns. Details are given of the experimental technique, and results are given for distribution coefficients. The method described is suitable for separating up to 150 mg. Sc from rare earths and yttrium as minor constituents (up to 1%), and a modified procedure is also given for separating rare earths and yttrium from Sc as a minor constituent. Certain oxalate soluble elements, such as U, are eluted from Dowex 50 more readily than Sc and are likewise similarly separable from rare earths. Tracer techniques were employed in the studies described. (UK)

24281 RAPID SOLVENT EXTRACTION OF TITANIUM(IV) WITH TRIBUTYL PHOSPHATE. Yadav, A.; Khopkar, S. M. (Indian Inst. of Tech., Bombay). Anal. Chim. Acta, 45: 355-7 (Apr. 1969).

A study of the solvent extraction of titanium(IV) with tributyl phosphate (TBP) was made using magnesium chloride, aluminum chloride, and lithium chloride as salting-out agents. Quantitative extraction was obtained from 5 M HCL containing 11 M lithium chloride. Aluminum chloride in 1 to 2 M HCl gave low distribution ratios, as did 1 to 2 M magnesium chloride; 4 M magnesium chloride gave the optimal conditions for extraction. Tolerance limits of diverse ions are given for the solvent extraction using 4 M $MgCl_2$. The average recovery of Ti was 98.8 to 1.2%. The standard deviation was 1.2% in 10 determination of 503 μg of Ti. (D.H.M.)

24282 USE OF TRILAURYLAMINE IN PARTITION CHROMATOGRAPHY. PART I. THE SEPARATION OF NEPTUNIUM FROM CONCENTRATED URANIUM SOLUTIONS. Gourisse, D.; Chesne, A. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France). Anal. Chim. Acta, 45: 311-19(Apr. 1969). (In French).

The partition of neptunium(IV) between nitric acid–uranyl nitrate solutions and Kel-F powder coated with a trilaurylammonium nitrate solution was studied in order to determine the optimum operating conditions for separating neptunium from uranium. The reversed-phase partition chromatography was performed by passing a 2 N HNO_3–0.1 M iron(II) solution containing up to 100 $g.l^{-1}$ of uranium, through a column of TLA–HNO_3–Kel-F beads. After washing the column with N nitric acid containing iron(II) sulfamate, the neptunium is eluted with a sulfuric acid–nitric acid mixture. The method is very selective for neptunium(IV), and allows a good separation from fission products, plutonium and uranium. It was applied to solutions in which the weight ratio U/Np is greater than 10^{10}, and to the preparation of radiometrically pure ^{239}Np. (auth)

24283 USE OF TRILAURYLAMINE IN PARTITION CHROMATOGRAPHY. PART II. SIMULTANEOUS SEPARATION OF NEPTUNIUM AND PLUTONIUM FROM URANIUM. Gourisse, D.; Chesne, A. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France). Anal. Chim. Acta, 45: 321-5(Apr. 1969). (In French).

A simultaneous separation of neptunium and plutonium from uranium is proposed, involving the partition of these two elements between a column of Kel-F coated with a trilaurylammonium nitrate solution and aqueous nitrate solutions. Neptunium(IV) and plutonium(IV) are fixed from a nitrate solution containing iron(II)–iron(III) to adjust the valence states. After washing the column with nitric and chlorhydric solutions, the neptunium and plutonium are eluted with a sulfuric–nitric acid mixture, and the analysis is completed by α-radiometry. (auth)

24284 POTENTIOMETRIC DETERMINATION OF FLUORINE IN NUCLEAR FUEL REPROCESSING SOLUTIONS. Moeken, H. H. Ph.; Eschrich, H.; Willeborts, G. (Eurochemic, Mol, Belgium). Anal. Chim. Acta, 45: 233-41(Apr. 1969).

The determination of fluoride in zirconium decladding (Zirflex) solutions, uranium feed solutions, and uranium final product solutions is described. The procedures are based on potential measurements of a fluoride-sensitive electrode versus a saturated calomel electrode after a relatively simple pre-treatment of the sample, e.g., dilution, complexing of metal constituents or separation by a cation exchange column. (auth)

24285 AQUEOUS TECHNIQUES OF REPROCESSING IRRADIATED NUCLEAR FUELS. Boetius, I.; Rabold, H. (VEB Kernkraftwerksbau, Berlin). Kernenergie, 12: 1-8(Jan. 1969). (In German).

Aqueous techniques of reprocessing including head-end processes, solvent extraction methods, and ion exchange processes are discussed. (auth)

24286 MOLYBDENUM AND NIOBIUM REDUCTION FROM CHLORIDE MELTS WITH LEAD. Vasin, B. D.; Nichkov, I. F.; Raspopin, S. P. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met., No. 1, 63-6(1969). (In Russian).

The equilibrium constants of the displacement of Mo and Nb from chloride melts with lead were calculated. Tests were made on the interaction of chloride melts containing Mo and Nb with lead. Test results showed that Mo is almost completely reduced by lead, whereas Nb is reduced only partially. Insignificant quantities of Mo and Nb pass over to the lead. (tr-auth)

24287 PRECIPITATION TREATMENT OF MEDIUM LEVEL LIQUID WASTE. Chen, Min-nan; Tseng, Chia-lain (National Tsing Hua Univ., Hsinchu, Taiwan). Ho Tsu K'o Hsueh, 6: 105-11(Oct. 1968). (In Chinese).

The treatment of medium-level liquid waste generated from the production of ^{32}P, ^{35}S, ^{51}Cr, ^{60}Co, and ^{131}I at the National Tsing Hua University was studied with respect to the individual nuclide, and then with the mixed waste. It was found that barium salt is a simple and effective chemical for treating ^{32}P (PO_4^{3-}) ^{35}S (SO_4^{2-}), and ^{51}Cr (CrO_4^{2-}) waste. From basic solutions the hydroxide precipitation method is more suitable for treating the ^{60}Co (Co^{2+}) waste. Silver nitrate or a 1:1 mixture of activated charcoal and copper sulfate is good for treating ^{131}I (I^-) waste. Mixed waste was decontaminated by the addition of all of the reagents employed in the individual treatment. The decontamination factors were ^{32}P 99.1%, ^{35}S 100%, ^{51}Cr 99.5%, ^{60}Co 99.2%, ^{131}I 98.1%, and mixed waste 99.9%. The advantages and disadvantages of the ^{51}Cr, ^{60}Co, and ^{131}I waste treatments are also discussed. (auth)

24288 PHYSICAL SEPARATION METHODS. Wilson, Cecil L.; Wilson, David W. (eds.). Comprehensive Analytical Chemistry. Volume IIB. New York, American Elsevier Publishing Company, Inc., 1968. 456p. $25.00.

Information is presented on: liquid chromatography in columns; gas chromatography; ion exchangers; and distillation. The chapter on ion exchangers is notable for the examples it gives of analytical applications. (P.C.H.)

24289 SAFETY COUNTERMEASURES IN SPENT-FUEL REPROCESSING PLANTS. Oyama, Yoshitoshi (Tokyo Inst. of Tech.). Anzen Kogaku, 7: No. 2, 96-101(June 1968). (In Japanese).

It may be assumed thermal reactors will play a major role in nuclear power generation during the next 20 years, and that 2000 tons of enriched uranium will be consumed as a fuel for reactors by 1975. Therefore, safety countermeasures for the processing of spent-fuel are very important. A plan is in progress for the construction by 1971 of a spent-fuel reprocessing plant capable of reprocessing 200 tons per year. Safety countermeasures for ventilation of radioactive waste gases and disposal of waste liquor in such plants are described. Reprocessing, including solvent extraction methods, is also discussed. (NSA of Japan)

24290 STABILITY OF LANTHANIDE COMPLEXES WITH α-HYDROXYCARBOXYLATES. Thun, H. (Rijksuniversiteit, Ghent). Meded. Vlaam. Chem. Ver., 30: 28-30(Jan.-Feb. 1968). (In Flemish).

Ion-exchange methods were developed for separation of some lanthanide ions. A potentiometric method conducted at 25°C was used to determine the complexes of lanthanide ions with isobutyl methyl glycolate, isopropyl methyl glycolate, dipropyl glycolate, diethyl glycolate, phenyl glycolate, and phenyl methyl glycolate. The differences in stability between the complexes of two adjacent ions were, in general, smaller than those observed for α-hydroxyisobutyrate, except for phenyl methyl glycolate. For the latter 2 ligands the distribution coefficients of their lanthanide complexes were determined by batch experiments with cation exchange resin. In these results confirmation of the potentiometric investigation results was found. Separation of 4 lanthanide ions was performed on a cation exchange column using these 2 ligands as eluting agents. Thus, Tb, Gd, Eu, and Sm could be obtained free of each other using a Dowex 50-W X-8 column. (BBB)

24291 FUNDAMENTAL STUDY ON THE TREATMENT OF NUCLEAR FUEL REPROCESSING WASTES BY FLOTATION METHOD. PREFERENTIAL REMOVAL OF MIXED FISSION PRODUCTS. Koyanaka, Yoshio (Kyoto Univ.). Nippon Genshiryoku Gakkaishi, 11: 198-205(Apr. 1969). (In Japanese).

As a part of fundamental studies on the treatment of nuclear fuel reprocessing wastes with the application of flotation techniques, experiments were undertaken on the preferential removal of long-lived fission products such as ^{137}Cs, ^{90}Sr, ^{106}Ru, ^{144}Ce, and ^{95}Zr from simulated low- and intermediate-level radioactive liquid wastes. Using either sodium oleate or octadecylamine acetate as the flotation collector, and cupric ferrocyanide or ferric hydroxide as the coprecipitant, three-stage preferential flotation was applied, resulting in the removal of 95% of ^{137}Cs, 87% of ^{90}Sr, and over 98% of a mixture of ^{144}Ce, ^{106}Ru, and ^{95}Zr. The amount of radioactive sludge required to treat 1,000 ml of simulated radioactive waste solution was less than 150 mg. (auth)

24292 REPROCESSING OF IRRADIATED FUELS. Zifferero, Maurizio. Com. Naz. Energ. Nucl., Notiz., 15: No. 2, 53-60(Feb. 1969). (In Italian).

General considerations of the reprocessing of irradiated nuclear fuels are reviewed. Technical and economic aspects of reprocessing fuels in Italy are discussed. (auth)

24293 ISOLATION OF RADIONIOBIUM FROM γ-IRRADIATED MOLYBDENUM OXIDE. Ueno, Kaoru; Saeki, Masakatsu; Ishimori,

Tomitaro (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 6: 203-6(Apr. 1969).

A reverse-phase chromatographic isolation procedure for Nb from Mo and Tc is given. The separation is performed with TBP (tri-n-butyl phosphate) on a celite column. Molybdenum oxide was irradiated with 20-MeV bremsstrahlung, which produces a mixture of ^{93m}Mo, ^{99}Mo; ^{99m}Tc; ^{91m}Nb, ^{95m}Nb, ^{95}Nb, and ^{96}Nb. The irradiation was applied to a 6N HCl solution of the target. Separation was repeated twice, which resulted in isolation of the radioniobium with a decontamination factor of 10^4 both for Mo and for Tc. Decay analysis of the activity showed that radioniobium thus separated was composed of ^{91m}Nb, ^{95m}Nb, ^{95}Nb and ^{96}Nb. The γ-spectrum of ^{96}Nb was obtained by subtraction of the spectrum taken 119 hr after the end of irradiation from that of 74 hr. (auth)

24294 SEPARATION OF MOLECULES AND MOLECULAR DIFFRACTION: DIFFRACTION AND TUNNEL EFFECT OF ISOTOPES. Koch, F. (Babes-Bolyai-Univ., Cluj). Kernenergie, 11: 295-6(Nov.-Dec. 1968). (In German).

The diffraction and tunnel effect of isotopes in the separation of molecules and in molecular diffraction are considered to show how the picture of the behavior of ions with different masses in electric fields must be supplemented from the classical picture and calculations. In reflection and tunneling there is a mass separation as there is in electric fields for ions of different energies. (J.S.R.)

24295 FLUIDIZED-BED COMBUSTION OF GRAPHITE-BASE NUCLEAR REACTOR FUELS. Witte, Hartmut O. (Oak Ridge National Lab., Tenn.). Ind. Eng. Chem., Process Design Develop., 8: 145-9(Apr. 1969).

The first step in a proposed processing method for the recovery of uranium and thorium from graphite-base nuclear reactor fuels is the combustion of the fuel in a fluidized bed of alumina. The reaction kinetics involved in this process was analyzed, and an empirical equation for the combustion rate was derived, from which the effects of temperature, feed-gas composition, and particle diameter on the combustion rate could be predicted. The experimental results from fluidized-bed combustion studies on both unirradiated and irradiated fuel specimens compared favorably with the predictions. (auth)

24296 SOLVENT EXTRACTION OF ALKALI METAL TETRAPHENYLBORATES. Sekine, Tatsuya; Dyrssen, David (Univ. of Goeteborg). Anal. Chim. Acta, 45: 433-46(May 1969).

The extraction of sodium and small amounts of potassium, rubidium, and cesium from aqueous solutions containing sodium tetraphenylborate (TPB), sodium perchlorate, and perchloric acid was studied for nitromethane, nitroethane, nitrobenzene, methyl isobutyl ketone, and tributyl phosphate. Nitromethane gives the highest distribution ratio (org/aq) for the perchlorates, and nitrobenzene gives the highest distribution ratio and separation factor for the tetraphenylborates. Most distribution data could be explained by assuming that the tetraphenylborates were fully dissociated in both phases. The equilibrium constants and distribution ratios increase in the order sodium < potassium < rubidium < cesium. The distribution ratio of small amounts of the heavy alkali metal ions will thus not be appreciably influenced by the concentration of sodium tetraphenylborate, but will decrease on the addition of sodium chloride or perchlorate. The effect of perchloric acid can be explained by irreversible acid hydrolysis of the tetraphenylborate ion. (auth)

24297 ELIMINATION OF PHOSPHATE IN DEHAFNIATED HYDRATED ZIRCONIA. Prevost, Sylviane (Faculte des Sciences, Paris). Bull. Soc. Chim. Fr., No. 3, 762-4(Mar. 1969). (In French).

A total elimination of phosphate ions contained in dehafniated hydrated zirconia was achieved by using ethylamine as an alkaline hydrolysis agent. The final products were tested by photometry and ir spectroscopy. (auth)

24298 ISOTOPIC FRACTIONATION BETWEEN GASEOUS AND CONDENSED CARBON DIOXIDE. Grootes, P. M.; Mook, W. G.; Vogel, J. C. Z. Phys., 221: 257-73(1969).

The isotopic fractionation in the equilibrium liquid-vapor system of carbon dioxide was measured for both the carbon and oxygen isotopic species in the temperature range 220 to 303°K. The $^{12}C^{16}O^{18}O$ isotopic species is somewhat less, and $^{13}C^{16}O_2$ slightly more volatile than $^{12}C^{16}O_2$, while the fractionation in both cases approaches zero at the critical temperature. The theoretical expression derived for isotopic fractionation in two phase equilibria qualitatively accounts for the observed direction of the enrichment but fails to explain its disappearance at the critical point. A temperature dependence of the binding energy and intermolecular vibration frequency is proposed to bring the theory into accordance with observation. The magnitude of the unknown term in the fractionation caused by internal effects (including hindered rotation) is obtained by subtraction. It is of the same order of magnitude as the other terms. (auth)

24299 A MECHANISTIC ANALYSIS OF FISSION GAS HOLDUP BEDS. Underhill, Dwight W. (Harvard School of Public Health, Boston). Nucl. Appl., 6: 544-8(June 1969).

The release of short-lived isotopes of krypton and xenon may be delayed by passage through an adsorbent bed. Such a process results in the effective removal of these radionuclides if the holdup time is long in comparison with their half-lives. Mechanisms influencing the efficiency of this type of holdup bed include molecular diffusion, eddy diffusion, and mass transfer resistance. At low carrier gas velocities, molecular diffusion is the controlling factor; at intermediate carrier gas velocities, eddy diffusion is more important; at high carrier gas velocities, mass transfer resistance dominates. A procedure described here permits the effect of mass transfer on the removal of each fission gas isotope to be calculated. If these effects are ignored, the efficiency of a fission gas holdup bed can be greatly overestimated. (auth)

24300 UNIFIED APPROACH TO TWO-REGION IONIZATION-EXCITATION DENSITY CALCULATIONS. Miley, George H.; Thiess, Paul E. (Univ. of Illinois, Urbana). Nucl. Appl., 6: 434-51(May 1969).

A method is developed to evaluate the spatial dependence of the energy spectrum of charged particle currents entering a process fluid from a bordering solid fuel region. This enables calculation of spatially dependent ionization-excitation rates including the general case where the formation rate varies with particle energy. Nondimensional plots permit application of the results to various fluid-fuel combinations and, with adjustment of two parameters, they may also be used for various particles including fission fragments, betas, alphas, and protons. The example of excitation of helium by alpha irradiation is examined in some detail. (auth)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 24104, 24476, and 24477.

24301 (ORO-490-17) RADIOACTIVITY TRANSPORT IN WATER. INTERACTION BETWEEN FLOWING WATER AND BED SEDIMENTS. (Texas Univ., Austin. Environmental Health Engineering Research Lab.). [1968]. 165p. (EHE-69-3; CRWR-36). Dep. CFSTI.

The delay in transport of radionuclides caused by the interaction between flowing water and bed sediments was determined. This interaction phenomenon for cesium-137 was observed by using a set of flumes, each 50 feet in length and a model river which was 200 feet long. The greatest uptake rate, K_{st}, by bed sediment was 88.7×10^{-4} [(cpm/cm^3)/(cpm/cm^3)]/(sec) with a velocity of 1.65 fps and a flow rate of 0.345 cfs/ft. In this case the sediment transport rate was 0.0795 lbs/sec-ft. A mathematical model was developed describing the migration of radionuclides into the sediments. The relative concentration of radionuclides on the surface of the bottom sediments to that in the bed sediment was found to be a function of $z/(2\sqrt{Dt})$, where z, D, and t, respectively, are the depth of bed sediment from the surface, diffusion coefficient of cesium-137 in water, and time after migration started. (auth)

24302 (UCRL-50554) LOADING-UNLOADING PV CURVES FOR TUFFS FROM THE NEVADA TEST SITE. Stephens, D. R.; Louis, Hedley; Lilley, E. M. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 20, 1969. 30p. Dep. CFSTI.

The pressure-volume curves of ten tuffs from the Nevada Test Site were measured to 40 kbar at 22°C. Data for the water-saturated samples showed the phase transitions due to free water at about 10 and 22 kbar. Water freezes at 10 kbar, and transforms from pseudo-orthorhombic to the bcc structure at 22 kbar. However, the presence of "nonliquid" water, which is loosely contained within the lattice of clay or zeolite minerals or adsorbed on particle surfaces, was also observed. The dry tuffs exhibited behavior typical of weak compressible rock. The bulk modulus is constant from zero to 100 bars, followed by a very compressible region where voids are rapidly removed as a function of pressure. The bulk modulus does not approach its original value until pressures of 2 kbar or more are reached. (auth)

24303 (UCRL-50566) DETAILED GEOLOGY OF THE PROPOSED DRAGON TRAIL EXPERIMENTAL SITE, RIO BLANCO COUNTY, COLORADO. Sterrett, Thomas S. (California Univ., Livermore. Lawrence Radiation Lab.). Feb. 27, 1969. 32p. Dep. CFSTI.

Project Dragon Trail is a tight-reservoir, natural gas nuclear stimulation experiment to be conducted jointly by the U. S. Government and private industry. The geologic conditions of the proposed site in Rio Blanco County, Colorado are described. A general geologic description of the area and a detailed geologic evaluation of the immediate vicinity of the proposed site is included. Geologic conditions relevant to Plowshare activities and the physical parameters of the test medium, necessary for predictive calculations, are discussed. The complete geologic evaluation indicates that the proposed site will be geologically acceptable for the Dragon Trail experiment. (auth)

24304 ON THE EFFECTS OF NUCLEAR EXPLOSIONS IN ROCKS AND ON THE CONSEQUENT CHANGES IN THE RELATIVE ELASTIC FIELD. Caloi, Pietro; Spadea, M. C. Ann. Geofis. (Rome', 19: 335-59(1966). (In Italian).

Results achieved concerning the elastic field changes produced in solid mediums near a shotpoint by conventional or nuclear explosions are summarized. Such alterations may be subdivided into four subzones: melted zone, crushed zone, cracked zone (where plastic currents flow), and indefinite elastic zone. The consequences of such alterations on the determination of the elastic modulus in a rock system are discussed. (Geophys. Abstr.)

24305 MEASUREMENTS OF THE RADIOACTIVITY OF SURFACE WATER AND SEWAGE IN HAMBURG. Effenberger, E.; Haschke, J. (Untersuchungsanstalt fuer Staedthygiene, Hamburg). Arch. Hyg. Bakteriol., 151: 740-52(Dec. 1967). (In German).

Methods for evaluation of α- and β-activity contained in the Elbe, the Alster, and the Bille Rivers and in sewage effluent from hospitals in Hamburg are described, and concentrations of radioactivity recorded for the period 1961 to 1967 are presented and discussed. In the Elbe the α activity ranged as high as 11 pCi/l, and the β activity/g of dry residue reached 100 pCi/g. Total β activity in the Alster reached ~60 pCi/l. The total β activities in hospital sewage effluent reached values as high as 20,000 pCi/l for very brief periods and averaged from 50 to 1000 pCi/l for the study period. In general, the residual β activities of the surface waters decreased considerably after the cessation of nuclear tests, but α activity increased slightly in the Elbe River. The largest sources of β activity in the sewage of Hamburg were the hospitals which employed radioisotopes. (BBB)

24306 STEADY STATE SOLUTIONS FOR THE DIFFUSION EQUATIONS OF ^{222}Rn DAUGHTERS. Wrenn, McDonald E.; Rosen, Jerry C.; Van Pelt, Wesley R. (New York Univ., N. Y.). Contract AT(30-1)-3086. Health Phys., 16: 647-56(May 1969).

A mathematical model describing steady state diffusion of radon-222 daughters, based on a uniform distribution of radon, was developed. Solutions are generated for four coupled non-homogeneous differential equations satisfying the boundary conditions that the concentrations of all daughters vanish at the walls for cylindrical geometry. The solutions of these equations give the concentrations of RaA, RaB, RaC and RaD as a function of the distance from the center of the containing vessel in terms of the diffusion coefficient, the radioactive decay constants, and the dimensions of the containment vessel. The results, integrated over the volume of the container and expressed as a fraction of the radon concentration, yield parent-daughter equilibrium values for cylinders of various dimensions. When the cylindrical geometry is used to approximate a uranium mine tunnel with a diameter of 8 ft, the model indicates that a significant parent-daughter disequilibrium exists using a value of the diffusion constant characteristic of unattached ions or atoms. Under non-static conditions, convective or turbulent mixing would further decrease the daughter concentrations relative to radon due to an increased concentration gradient at the wall; the presence of aerosols would, however, tend to reduce the rate of diffusion to the walls. (auth) (UK)

24307 RADIOMETRIC DATING FOR GEOLOGISTS. Hamilton, E. I.; Farquhar, R. M. (eds.). New York, John Wiley and Sons, Inc., 1968. 511p. $19.50.

Potassium-argon dating of igneous and metamorphic rocks is applied to the rocks in Basin ranges of Arizona and Sonora. A comparison of the isotopic mineral age variations and petrologic changes induced by contact metamorphism is made. Isotopic geochronology of igneous and metamorphic rock of Montana and Wyoming and the geochronology of sedimentary-volcanic assemblages in Connemara and Murrisk, Ireland are presented. The interpretations of lead isotopes and their geologic significance and zircon ages are given. Radiometric dating and the pre-Silurian geology of Africa are discussed. Charged particle tracks used for tools for geochronology and meteorite studies are described. The isotopic composition of strontium applied to problems of the origin of the alkaline rocks is summarized. (J.C.W.)

Meteorology

Refer also to abstract 26061.

24308 (BARC-393) TRANSPORT AND INTER-HEMISPHERIC MIXING OF RADIOACTIVE DEBRIS FROM RECENT NUCLEAR TESTS. Rangarajan, C.; Gopalakrishnan, Smt. S. (Bhabha Atomic Research Centre, Bombay (India)). 1969. 20p. Dep.

The tropospheric radioactivity released by the Chinese tests in the northern hemisphere (40°N) and the French tests in the southern hemisphere (22°S) have been used as tracers in studying the movement of air masses within the hemisphere and across the equator. The variations in the activity and the ratios of selected pairs of fission products show that debris is carried by westerly winds in temperate and sub-tropical latitudes circling the globe in two to three weeks. Surprisingly, southern hemispheric debris is also detected in about three to four weeks in India. The preferential detection of the southern hemispheric debris in significant quantities suggests massive transfer of southern hemispheric air in the Indian Ocean region during summer monsoon period when the convergence zone moves to the north of India. (auth)

24309 (NVO-162-28) RADIOLOGICAL CONDITIONS AT PROJECT ROLLERCOASTER SITES, 1966. (Reynolds Electrical and Engineering Co., Inc., Mercury, Nev. Radiological Sciences Dept.). Jan. 1967. 38p. Dep. CFSTI.

Results of surveys made in January and June of 1966 of the con-

taminated areas associated with Project Rollercoaster are presented. Data tabulated from air, swipe, and water samples are given to determine changes in the distribution of ^{239}Pu surface contamination released during testing. The ^{239}Pu is present in sufficient quantity to constitute a health hazard unless adequately controlled. Studies and evaluations were made of surface wind conditions over the last five years in an effort to predict possible Pu distribution beyond the boundaries of the test range. (F.S.)

24310 (UCRL-Trans-10340) RATIOS OF RADIONUCLIDES OF STRONTIUM IN THE FALL-OUT AFTER THE THIRD NUCLEAR TEST IN CHINA. Santholzer, Vilem; Stransky, Pravoslav; Knaifl, Josef. Translated by V. Nefton for Univ. of California Lawrence Radiation Lab., Livermore, from Jad. Energ., 13: 184-5(1967). 8p. Dep. CFSTI.

An abstract of this paper, prepared from the original language appeared as NSA 21: 28104. (L.C.L.)

24311 MEASUREMENT OF ^{210}Pb IN SURFACE AIR AND PRECIPITATION. Joshi, L. U.; Rangarajan, C.; Gopala Krishnan, S. Sarada (Bhabha Atomic Research Center, Bombay). Tellus, 21: 107-12(1969).

Lead-210 activity in ground-level air and rainwater at a number of stations in India covering the latitude band 11 to 34°N was studied and the data are presented. Seasonal variations in activity levels with maximum values in winter were observed in the surface air at several stations. The time of occurrence of peak values of lead-210 differed from that of stratospheric cesium-137 but generally agreed with radon levels. It was therefore concluded that lead-210 was mainly controlled by radon activity in the ground-level air. The possible reasons for the winter peak in radon and lead-210 were discussed. The latitudinal variation of lead-210 and the likely reasons for these were examined. The lead-210 activity levels in India were compared with the values reported by other laboratories for temperate latitudes. (Sweden)

24312 NUCLEAR FALLOUT AND RADIOACTIVE PARTICLES FROM CHINESE ATOMIC EXPLOSIONS. Santholzer, Vilem; Stransky, Pravoslav. Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove, 10: Suppl., 437-43(1967). (In Czech).

Fallout from the Chinese nuclear explosions was found in Czechoslovakia as well as in other countries. The French nuclear tests in Polynesia did not cause any increase of activity in Czechoslovakia. Methods of determination of fresh fallout were of various kinds. The spectrometric proof of fresh fission products was considered to be the most accurate and reliable. Fresh fission products were also proved by systematic measurements of beta activity, by observing the time decrease in activity, by measuring the half-value layer for beta particles in the freshly separated strontium, and by measuring the specific activity of atmospheric precipitations. (auth)

24313 AEROSOL RESEARCH ACTIVITIES AT THE HEALTH AND SAFETY LABORATORY, U. S. ATOMIC ENERGY COMMISSION: 1968. Thomas, Jess W. (Atomic Energy Commission, New York). J. Air Pollut. Contr. Ass., 18: 685-7(Oct. 1968).

The aerosol research program at the USAEC Health and Safety Laboratory to investigate and minimize the hazard arising from radioactive particles produced in atomic energy activities is reviewed. The Laboratory is interested, for example, in air filters and other air sampling equipment, plant filtration systems, and in the deposition and retention of radioactive particles in the human respiratory tract. Aerosols in the size range of about 0.2 to 10 μ dia were produced by use of the polystyrene latex solutions or the spinning disc generator. Two current projects utilize these monodispersed aerosols of known charge and density. One is a study of filtration of aerosols by filter papers, and a recalibration of size-selective samplers. Other projects are generation and measurements of aerosols under 0.1 μ dia, the diffusion rate of the Ra A atomic aerosol, and the respiratory deposition of Rn daughters. Measurements of the diffusion rate of this atomic aerosol are under way, as a function of age of the Ra A atom, presence or absence of ionizing radiation, and relative humidity. Measurements have shown a diffusion rate of 0.06 cm^2/sec, corresponding to a size of 0.001 μ dia. (BBB)

24314 AN OUTLINE OF RESEARCH AT PACIFIC NORTHWEST LABORATORY RELATED TO AIRBORNE PARTICLES. Schwendiman, L. C. (Battelle Memorial Inst., Richland, Wash.). J. Air. Pollut. Contr. Ass., 18: 679-80(Oct. 1968).

Research at the Pacific Northwest Laboratory involving small particles is discussed in 5 areas: aerosol physics research, atmospheric sciences research, life sciences research, nuclear safety research, and small particle analytical techniques. Study of the traces of fission product elements sampled from various elevations in the atmosphere has given insight into global scale air circulation patterns. Studies of naturally occurring cosmic-ray-produced nuclides have amplified knowledge of the chemical constituents in the atmosphere. These studies are made possible by sophisticated sampling and very sensitive radiochemical techniques that have been developed. Attempts are being made to establish the behavior, principally the removal rate, for particles and gases released in a serious loss of reactor coolant accident. Experiments have been carried out in the 30,000 ft^3 containment vessel to determine the removal rate of airborne cesium, tellurium, ruthenium, barium, iodine, and uranium by natural processes in a steam atmosphere. Plutonium aerosols released during overheating and combustion of various materials containing plutonium compounds are being investigated to establish the fraction and nature of plutonium which will be airborne in a fire. (BBB)

24315 AERODYNAMIC EFFECTS OF THE EBR-II REACTOR COMPLEX ON EFFLUENT CONCENTRATION. Dickson, C. R. (National Reactor Testing Station, Idaho Falls, Idaho); Start, G. E.; Markee, E. H. Jr. Nucl. Safety, 10: 228-42(May-June 1969).

Dispersion of a tracer released from the downwind side of the Experimental Breeder Reactor II (EBR-II) was measured in the stable and unstable atmospheres. The tracer, uranine dye, was sampled on five concentric sampling arcs between 30 and 600 m from the release point. The average tracer concentrations at the plume center were proportional to the -0.6 power of distance downwind. The downwind-to-upwind ratios of the product of vertical and horizontal turbulence indices were calculated from bivane data records. At 100 m downwind the ratio exceeded 15 for some 5-min data records and averaged 5 for the 30-min records. The horizontal wind speed immediately downwind in the wake of the reactor complex averaged about one-half the horizontal speed upwind of the complex. The diffusion rate in the EBR-II wake converged to the "free" atmosphere rate between 400 and 600 m downwind of the source point. (auth)

24316 FALLOUT GAMMA-EMITTING RADIONUCLIDES IN AIR, PRECIPITATION, AND THE HUMAN BODY UP TO SPRING 1967. Lindblom, Gunnar (Research Inst. of National Defence, Stockholm). Tellus, 21: 127-35(1969).

Results from measurements of some radionuclides (especially cesium-137) in stratospheric air, ground-level air, precipitation, and the human body are discussed. First during 1967, four years after the cessation of large-scale atmospheric testing in late 1962, the supply of stratospheric cesium-137 to the ground will be balanced by decay of the activity already deposited. Average cesium-137 body burdens have since the maximum values occurred during 1964 been halved in every 1.5 year. Internal and external gamma-doses were calculated. Measured ratios between some other longlived radionuclides and cesium-137 are discussed. Some beryllium-7 concentration figures are reported. (Sweden)

24317 ON SOME RESULTS OF MEASURING RADIOACTIVITY OF INDIVIDUAL RAINDROPS. Styro, B. I.; Vebriene, B. K. (Inst. of Physics and Mathematics, Vilnius, USSR). Tellus, 21: 89-94(1969).

A method of measuring the radioactivity of separate raindrops and ice-crystals by capturing them on the sampling surface, with subsequent contact with nuclear emulsion A-2, is described. The number of nonradioactive raindrops is defined. It is shown that for continuous rain the percentage of nonradioactive raindrops is near 30%. The average radioactivity value of individual raindrops increases with their size. The rise of this radioactivity value slows down as the size of droplets increases. The specific radioactivity of raindrops increases with the decrease of their size. Hence, the value of raindrop evaporation by fall from the cloud to the ground is obtained. It is shown that the frequency maximum of raindrops having identical specific radioactivity takes place. On the assumption of a simplified activation scheme of raindrops in the cloud, it is shown that the processes there are quite nonstationary. (Sweden)

24318 CONTINUOUS MEASUREMENT OF NATURAL RADIOACTIVITY IN THE NEAR-GROUND ATMOSPHERE BY IONIZATION CHAMBER. Murayama, Nobuhiko (Meteorological Observatory, Nagoya, Japan); Okashi, Nobuo. Kishocho Kenkyu Jiho, 20: 329-38(June 1968). (In Japanese).

Two modified Kawano-type ionization chambers for $\alpha\beta\gamma$ and $\beta\gamma$ measurements were constructed, and the long-time observation of natural radioactivity was continuously carried out at the Mito weather station. Details of instrument and its operating characteristics, especially feasibility for routine observation are described. Time variations, i.e., diurnal and seasonal variations, of the natural radioactivity are also presented. Correlation of natural radioactivity with meterological elements, i.e., air pressure, temperature or wind is shown with two examples. Lastly, it is found that the abrupt temporary drop of $\alpha\beta\gamma$ radiation appears in association with the early formation

of nocturnal temperature inversions at the lower levels. (NSA of Japan)

24319 LONG-LIVED RADIOACTIVITY IN HIGH MOUNTAINS FROM JAN. 1, 1965 TO DEC. 1965. Keck, Gertrud (Tieraerztliche Hochschule, Vienna). Wien. Tierarztl. Monatsschr., 54: 237-70 (Apr. 1967). (In German).

The long-lived artificial radioactivity contained in atmospheric fallout collected at altitudes of 1041 and 2348 m in mountains of Salsburg province, Austria located 7.5 Km apart was compared for the period 1961 to 1966. Total activity was small over the entire interval. The average increase in activity was 41%, which resulted largely from greater increases at the higher station. In decreasing order of activity found the major radionuclides were ^{137}Cs, ^{144}Ce, and ^{54}Mn. In May 1965, and in June and November 1966 several short-lived fission products were found also. The ^{137}Cs activities for different 2-month periods from 1961 to 1966 were compared. They varied from 0.009 to 0.090 pCi/m^3 of air. Hot particles found at the higher altitude from May 1965 to June 1966 consisted largely of $^{95}Zr-^{95}Nb$. The long-lived β activity persisted for several days after the maximum value was reached. Activity was also increased in October 1966. These increases were believed to result from the Chinese atomic bomb explosions of May 1965, and May and October 1966. The hot particles were detected earlier at the higher station than at the lower station. The ^{137}Cs in snow collected at the upper level station was compared for several days in December 1965 and for several months in 1966. The values ranged from 0.8 to 12.3 pCi of ^{137}Cs/snowfall. (BBB)

24320 THE LONG-LIVED RADIOACTIVITY IN THE AIR FOLLOWING THE CHINESE NUCLEAR WEAPONS TEST OF OCTOBER 28, 1966. Keck, G.; Kuester, M. (Tieraerztliche Hochschule, Vienna). Wien. Tierarztl. Monatsschr., 54: 25-6 (Jan. 1967). (In German).

Daily total atmospheric fallout activities for the months of October and November, 1966 in Salzburg province and the γ spectra observed are reported. Following the Chinese test of October 28, the first marked increase of atmospheric activity was measured on November 10. The activity of single particles prior to this date was less than 0.5×10^{-12} Ci. On November 10 a peak of 0.25×10^{-9} Ci was measured, followed by a peak of $\sim 10^{-9}$ Ci on November 15. The γ spectra of the samples from November 14 to 16 indicated peaks of ^{95}Zr, ^{95}Nb, ^{140}La, ^{147}Nd, ^{103}Ru, and ^{131}I. All of the activity values observed were below a hazard limit, and because of the late time of yr little ^{131}I was taken up by pasture grass or found in milk. (BBB)

24321 THE ^{90}Sr AND ^{137}Cs CONTENT IN ATMOSPHERIC FALLOUT, WATER, CERTAIN FOOD PRODUCTS, AND THE HUMAN BODY. Furnica, Gh.; Voicu, V. (Inst. of Hygiene, Bucharest). Igiena (Bucharest), 17: 289-95 (May 1968). (In Rumanian).

The results of determining the radioactivity in atmospheric fallout, water, and food products are given. The isotopes ^{54}Mn, ^{125}Sb, ^{137}Cs, and ^{144}Ce were determined by γ spectrometry. The value in pCi ^{90}Sr/g Ca and pCi ^{137}Cs/g K of various products was established. Along with the ^{90}Sr and ^{137}Cs content of the teeth, the value of the discrimination factors for ^{90}Sr and ^{137}Cs for some of the foods ingested by persons 11 to 21 yr old and children of different ages is presented. The data for 1964 are presented on the basis of 12 districts in Rumania, and data for food levels of radionuclides are tabulated for the periods 1941 to 5, 1946 to 50, 1951 to 5, 1956 to 8, and 1958 to 62. (BBB)

24322 AEC SPONSORED LABORATORY WORK WITH AEROSOLS. Beadle, Robert W. J. Air Pollut. Contr. Ass., 18: 690-1 (Oct. 1968).

Aerosol research related to fallout and atmospheric radioactivity programs is described. These studies were made for the development and testing of aerosol sampling devices and technology, and analytical techniques for sample analyses; better understanding of the mechanics of aerosol behavior and the role of aerosols in atmospheric processes contributing to the transport and deposition of nuclear debris; and increased knowledge of the chemistry and physics of the atmospheric aerosol. The origin, nature, and dynamic behavior of particles and radioactive halogen isotopes were studied with a primary interest in the modeling of deposition and re-entrainment of particles in airflow systems over a wide range of Reynolds numbers. Particle size analysis of radioactive particles collected on IPC 1478 filter media has led to new technology for conducting particle size and density studies on filter samples. The approximate particle size of nuclear debris attributed to the June 1967 Chinese nuclear test is being determined. Research in atmospheric chemistry, particularly heterogeneous gas-particle reactions or water-particle reactions and the mechanisms of aerosol removal from the atmosphere, is also considered. (auth)

Mineralogy and Exploration

Refer also to abstract 24392.

24323 (NP-17852) SWEDISH URANIUM POLICY. (Industridepartementet, Stockholm (Sweden)). 1969. 59p. (In Swedish). Dep.

The increasing demand for uranium within Sweden is discussed. Ways are discussed for the supply of natural uranium by import, domestic production, and prospecting. Other major parts of the fuel cycle, enrichment, fuel element fabrication, and reprocessing are mentioned. It is concluded that until the end of the 1970s the Swedish demand could be secured by import. It is suggested that domestic large-scale production start in early 1968. (Sweden)

24324 ESTIMATES OF THE CRUSTAL ABUNDANCES OF THORIUM, URANIUM, AND POTASSIUM. Lambert, I. B.; Heier, K. S. (Australian National Univ., Canberra). Chem. Geol., 3: 233-8 (Dec. 1968).

Radioelement abundances in 2 crustal sections were estimated from surface heat flow, radioelement abundances at the surface and in medium to high pressure granulite facies rocks, crustal thickness, and assumptions of heat flow from the mantle. The abundances are 4.5 ppM Th, 0.7 (or 1.1) ppM U, 1.5% K in the Archaean shield of southwest Australia; 7 ppM Th, 1.3 (or 1.7) ppM U, and 1.7% K in the Paleozoic crust of east Australia. The radioactivity in the shield is strongly concentrated near the surface and the thickness of the surface layer is estimated to 4.5 Km. The radioelement abundances derived from the crustal model used were lower than most earlier estimates. The terrestrial Th/U ratio is generally assumed to be between 3 and 4 in analogy with stony meteorites. This is the ratio measured in most volcanic rocks. Plutonic rocks, particularly granites, metamorphic rocks, and sediments have variable and frequently high Th/U ratios. Low Th/U ratios (<1) are restricted to special rock types. Present estimates indicate Th/U ratios above 4 in both the shield and young crust sections. This is probably explained by the high solubility of the oxidized uranyl complex ion $(UO_4)^{2-}$ which would cause selective leaching of U relative to Th at lower grades of metamorphism than the major granulite facies depletion. High concentration of U in certain veins, pegmatites and sedimentary rocks were not considered in the distribution profiles. They may raise the U abundances closer to the values derived from Th/U ratios of 4. (BBB)

24325 URANIUM-BEARING VEINS IN PLATEAU STRATA, KANE CREEK, UTAH. Davidson, Donald M. Jr. (Univ. of Minnesota, Duluth); Kerr, Paul F. Geol. Soc. Amer., Bull., 79: 1503-26 (Nov. 1968).

Uranium deposits in the metallogenic province of the Colorado Plateau, with a few possible exceptions, are commonly peneconcordant, completely enclosed in sedimentary strata, and lack hydrothermal feeder dikes. Among the few exceptional vertical U-bearing structures penetrating Plateau strata are the deposits of Kane Springs Canyon, Utah, where evidence for upward migration of U ions may be critically examined. Here nearly vertical U-bearing mineralized fractures (age about 60 Myr) penetrate older strata (age about 225 Myr). Closely associated with the U minerals of the veins are clay minerals, chlorite, and a local development of micaceous foliation. While evidence in support of an original hydrothermal source for the U ions is strong, several links are missing in the interpretation of natural events which would tie the vertical fractures to deposits in overlying horizontal strata. Two periods of fluid invasion evidently caused mineral alteration along faults in the Cutler Formation at Kane Creek. Normally, red and purple strata exhibit massive areas of bleaching up to 50 ft thick which gradually taper away from the faults and disappear within a mile or more. This early bleaching is followed by a later, localized green-gray clay-mineral alteration which ranges from a few inches to 20 ft thick and closely follows steeply inclined fault planes. These fault planes are U-bearing, with uraninite (UO_2) being the principal ore mineral. The mineral assemblage of the veins provides evidence that moderate- to low-temperature thermal solutions prevailed during the formation of the ores. (BBB)

24326 URANIUM RESOURCES IN JAPAN. Com. Naz. Energ. Nucl., Notiz., 15: 78-82 (Feb. 1969). (In Italian).

A review is presented of Japan's uranium resources, exploration work done and in progress, and future prospects. (auth)

24327 OUTLOOK FOR URANIUM. Gunning, Gerald D.; Springsteen, David F.; Winger, John G. New York, Chase Manhattan Bank, N.A., 1969. 24p.

A study of current world reserves of natural uranium, mining

industry requirements for locating new low cost uranium reserves, and demands for uranium to fuel power reactors for electric generation in the US and other free world countries concludes that adequate world reserves of U_3O_8 exist to meet world meets through 1980 at a marketable price of about $10 per lb in terms of constant dollars during 1968 to 1980. (L.C.L.)

Oceanography

Refer to abstract 24577.

Seismology

Refer also to abstract 24485.

24328 (NVO–1163-64) DIFFUSION OF SEISMIC ENERGY IN THE NEAR RANGE. Wesley, James Paul (Beers (Roland F.), Inc., Alexandria, Va.). Nov. 30, 1965. Contract AT(29-2)-1163. 36p. Dep. CFSTI.

It is assumed that the flow of seismic energy from an underground nuclear explosion or earthquake in the near range (less than 1000 km) may be estimated by the diffusion equation in cylindrical geometry with a diffusivity varying directly as the frequency. A term is included to allow for the dissipation of energy due to the anelasticity of the earth. The mean period and amplitude of a seismogram are thereby derived as functions of the time of arrival and range. The peak particle velocity is derived as a function of range. A preliminary comparison with observations of the seismic waves produced by an underground nuclear explosion indicates satisfactory overall agreement. (auth)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 24302, 24304, and 24328.

24329 (AD–678507) ACOUSTIC–GRAVITY WAVES PRODUCED BY ENERGY RELEASE. Cole, J. D.; Greifinger, C. (RAND Corp., Santa Monica, Calif.). Sept. 1968. Contracts DAHC15-67-C-0141; F33657-69-C-0107. 40p. (RM–5738-ARPA/AFT). CFSTI.

A complete asymptotic analysis is carried out for the flow field produced by the instantaneous release of energy, at a point on the ground, in an isothermal atmosphere. A double integral representation of the flow is constructed from Laplace–Handel transforms of the linearized equations. An asymptotic approximation to the integral is obtained by two successive applications of the method of stationary phase. It is found that there are three principal groups of dispersive waves behind the spherical acoustic front. One of these groups is contained in a high frequency band, and the other two are contained in a low frequency band. The spatial domain of the low frequency waves is cut off by a front (caustic), the location of which is calculated. Some of the characteristics of the flow are discussed. (auth) (USGRDR)

24330 (NVO–1163-38) ANALYSIS AND INTERPRETATION OF SQUARED FOURIER SPECTRA. Gorman, Richard L. (Beers (Roland F.), Inc., Alexandria, Va.). Jan. 29, 1965. Contract AT(29-2)-1163. 60p. Dep. CFSTI.

The squared Fourier spectrum obtained by squaring the absolute value of the Fourier transform of any of the usual measured quantities such as seismic displacement, velocity, or acceleration was interpreted. The V^2 spectra (squared Fourier spectra of the velocity) of the Klickitat Event was examined. The spectra, which were characterized by many narrow width functions in frequency as well as fluctuations in the magnitudes of the peaks, indicate that the spectra are reasonable and result from the effects of phase changes with frequency, finite duration of the existence of a given frequency, and resonance introduced by the shot and the earth. The effects of finite duration of a given frequency in producing resonances in the frequency domain and misleading characteristics are discussed in quantitative detail. The effect of stratigraphy in producing resonances is mentioned. (F.S.)

24331 (PNE–951) PROJECT CABRIOLET: CLOSE IN AIR BLAST FROM THE CABRIOLET EVENT. Vortman, L. J. (Sandia Corp., Albuquerque, N. Mex.). July 1968. 55p. Dep. CFSTI.

Results are given of pressure-time measurements measured by two gages at each of eight stations from surface ground zero to 6000 feet on the Cabriolet event. The largest overpressures resulted from the air-transmitted ground-shock-induced pulse and were comparable to those measured on the Danny Boy and Sulky events. There is evidence that for underground explosions as for aboveground explosions the air blast from a 1-kiloton nuclear explosion is comparable to that from ½ kiloton of TNT. The weak pulse from venting gas was also comparable to those from Danny Boy and Sulky and all were well below those from comparable TNT explosions. Comparisons between airblast from Cabriolet and that from Palanquin in the same medium are made. (auth)

24332 (UCRL–71453) UNDERGROUND ENGINEERING APPLICATIONS. Nordyke, M. D. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 1969. 24p. (CONF-690406–6). Dep. CFSTI.

From Symposium on Public Health Aspects of Peaceful Uses of Nuclear Explosives, Las Vegas, Nev.

The utilization of completely contained nuclear explosions in the Plowshare Program are discussed including the nature of the explosions, types of suggested uses, safety problems, and economic factors. Underground applications dealing with gas and oil stimulation, in-situ oil shale retorting, gas and oil storage, in-situ copper leaching and block cave mining are reviewed. Safety problems of ground motion and radioactivity are summarized. The costs of underground engineering, including the cost of the explosive and its emplacement, are briefly described. Currently active projects including Gasbuggy, Rulison, Dragon Trail, WASP/Pinedale, Sloop, and Ketch are summarized. (F.S.)

24333 (UCRL–71456) SUMMARY OF RESULTS OF CRATERING EXPERIMENTS. Toman, John (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 2, 1969. 45p. (CONF-690406–7). Dep. CFSTI.

From Symposium on Public Health Aspects of Peaceful Uses of Nuclear Explosives, Las Vegas, Nev.

Nuclear excavation as a construction technique for producing harbors, canals, highway cuts, and other large excavations requires a high assurance that the yield and depth of burst will produce the desired configuration. A better understanding of the changes generated in the cratering process by layered rock formations, such as those encountered in the Buggy, Cabriolet, and Schooner experiments is needed. Pre-shot insight into the nature of these changes was made possible by the use of cratering code calculations which use in situ and laboratory test data on rock samples of the formation. Nuclear excavation projects in untested formations can now be designed with a greater assurance that the depth of burst and yield can be specified to provide the desired structure. For nuclear excavation experiments conducted to date through the 100-kt level, no trend toward $\frac{1}{4}$ root scaling has been observed. A comparison of cratering data in three different materials (dry rock, alluvium, and shale) indicates that differences in physical properties affect crater dimensions more significantly than possible differences in yield scaling exponents. The rather small-scaled dimensions observed in the Buggy row-crater experiment should not be considered typical for large nuclear excavation projects. The presence of water at the shot point and in overlying formations, which is likely to be encountered in most locations away from the Nevada Test Site, is expected to increase the cratering efficiency of nuclear explosives. (F.S.)

24334 (UCRL–71489) SUMMARY OF RESULTS OF UNDERGROUND ENGINEERING EXPERIENCE. Holzer, Fred (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 18, 1969. 33p. (CONF-690406–8). Dep. CFSTI.

From Symposium on Public Health Aspects of Peaceful Uses of Nuclear Explosives, Las Vegas, Nev.

Results pertinent to the use of nuclear explosives in underground engineering applications have been accumulating for the past 10 years from the Plowshare and Weapons tests of the AEC. Thus, predictive and measurement techniques of shock effects and chimney formation were developed from analyzing explosions in granite, salt, and dolomite. The ability to predict effects related specifically to safety have resulted from many measurements on detonations at the Nevada Test Site, where also many of the techniques for handling, emplacing, and firing the explosive have been developed. This gestation period culminated in the execution of Project Gasbuggy, jointly sponsored by industry and government, and the first nuclear explosion in a gas-bearing formation. The Gasbuggy explosive had a nominal yield of 26 kt and was detonated 4240 ft below the surface in the San Juan Basin in northwestern New Mexico on December 10, 1967. The shot point was 40 ft below the lower boundary on a 285-ft-thick gas-bearing sandstone formation of very low permeability. No radioactive venting occurred, and no damage to surrounding gas wells or structures resulted. Post-shot geophysical exploration and gas production tests have revealed that the nuclear explosion created a subsurface chimney approximately 160 ft in diameter and 335 ft high. Fractures appear to extend to about 400 ft symmetrically from the detonation point, with shifts or offsets along geological weaknesses extending out to perhaps 750 ft. Presently, radioactive constituents in the gas consist of tritium and krypton-85, with concentrations of approximately 10 μCi/ft^3 and 1.5 μCi/ft^3 respectively. These concentrations are decreasing as gas withdrawn from the chimney is replaced by formation gas. Tests to evaluate the increase in productivity and ultimate recovery are currently in progress. (auth)

24335 (UCRL–71628) TECHNOLOGIES CURRENTLY USED IN NUCLEAR EXPLOSIVES ENGINEERING. Knox, Joseph B. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 24, 1969. 31p. (CONF-690312–4). Dep. CFSTI.

From Symposium on Education for the Peaceful Uses of Nuclear Explosives, Tucson, Ariz.

The technical problems whose solutions are necessary for the industrial development of Plowshare technology are described. These include the ability to predict the displacement and formation characteristics of craters and cavities formed by nuclear explosions in various underground media and the seismic and radiation effects. The scientific disciplines required to study these multiple problems are outlined. Examples are given of how these predictions have been made in the past, and predicted results are compared with Danny Boy Event measurements. (L.C.L.)

24336 EFFECT OF MATERIAL PROPERTIES ON CAVITY SIZE FROM AN UNDERGROUND NUCLEAR EXPLOSION. Allen, R. T.; Duff, R. E. (Applied Nuclear Co., La Jolla, Calif.). Nucl. Appl., 6: 567-72 (June 1969).

Finite difference techniques for the solution of the motion of an elastic-plastic solid are used to investigate the effects of rock strength and the cavity gas properties on the cavity size formed by a nuclear explosion. The material description includes the effect of pressure and temperature on the yield surface and the change of material description in the solid, liquid, and vapor phases. The results presented indicate a strong dependence of cavity size on the rock strength and a considerably lower sensitivity to the ideal gas coefficient, γ, assumed for the cavity gas. The results suggest that the cavity sizes observed in nuclear field tests can be better correlated with calculations by assuming strength parameters considerably lower than observed in laboratory tests on competent rock samples. (auth)

24337 AN ARTIFICIAL SEA PHENOMENA DUE TO THE HIGH-ALTITUDE NUCLEAR EXPLOSION. Kamada, Tetsuo (Nagoya Univ., Japan). Denki Gakkai Zasshi, 88-11: 2135-41 (Nov. 1968). (In Japanese).

With U. S. nuclear detonations over the Pacific in 1958 and 1962, a Geophysics Group in Japan discovered the similarity of artificial SEA (sudden enhancement of atmospherics) phenomena due to high altitude nuclear detonations and those by solar activity. The nuclear detonation at a high altitude causes a disturbance of the ionosphere, giving a means of detection of such detonations. In the abnormal radio-wave phenomena in a VLF layer, the SEA phenomenon is caused due to a solar-surface explosion; the high-altitude nuclear detonation also causes a similar SEA phenomenon. By observing the VLF-layer radio waves and the solar radio waves, the cause of a SEA phenomenon can be found. The description is made in the following: instances of the artificial SEA phenomenon; the mechanism of an ionosphere disturbance due to a nuclear detonation; and, changes in a D layer in atmospherics transmission due to a nuclear detonation. (NSA of Japan)

24338 AG RESEARCHERS TAKE PART IN NUCLEAR EXCAVATION STUDY. Shoemyen, Janos. Sunshine State Agr. Res. Rep., 12: 6-9(July 1967).

A program is outlined for studying the possible hazards due to the introduction of radioisotopes into food chains as a result of using nuclear explosives for canal excavation in Panama. The five major ethnic groups which inhabit the study area are described in terms of their distinctive agricultural systems which differ as to the type and manner of land use, and which, in turn, affect the uptake of radioactive fallout by man's food plants. Plans for environmental monitoring, for tracing the transport of radioisotopes in food chains, and for assessing the biological effects on man are mentioned. (BBB) (TSS)

24339 NUCLEAR EXCAVATION RESEARCH. Kurtz, Maurice K. Mil. Eng., 60: 327-32(Sept.-Oct. 1968).

Data obtained from laboratory and field experiments and project feasibility studies in nuclear excavation research are cited. The evidence indicates that nuclear explosives can be used in the construction of navigable channels, harbors, reservoirs, dams, underground storage facilities, and in rock quarrying. The advantage of nuclear excavation over conventional methods is economy of both money and time. The future development and application of civil nuclear explosives will depend largely upon the interest shown by the engineering profession. (Arms Contr. Disarmament)

24340 AN INTERPRETATION OF GASBUGGY. Elkins, Lincoln F. (Sohio Petroleum Co., Oklahoma City, Okla). J. Petrol. Technol., 20: 549(June 1968).

Preliminary post-shot results of the Gasbuggy nuclear detonation in the Choza Mesa-Pictured Cliffs gas reservoir, Rio Arriba County, N. M. gave rise to speculation in the oil industry that the shot failed to achieve the extensive fracturing forecast for the technique. Basis for this speculation is that on re-entry 1 month after detonation, an extrapolated pressure of 977 psia at the 4150-ft datum was encountered in contrast with an anticipated 1050 psia. Subsequent pressure buildup was very slow. Various considerations indicate that present limited gas production from the reservoir represents widespread areal recovery of gas from parts of the ultra-tight rock matrix immediately adjacent to the interconnected fracture system. The significance of the data in interpreting the pressure observations in the re-entered Gasbuggy well is that higher pressure gas from previously undrained sections in and adjacent to the 440-ft radius, 14-acre, nuclear fracture region not only is pressuring up the chimney, but also is recharging the native fractured zones that were more fully depleted by past production. If this interpretation is correct, the sustained capacity of the well after blowdown of the chimney should be very much greater than calculations based solely on apparent fillup of the chimney. Significant in predicting long-term performance of the well is the fact that the bulk of the reservoir rock beyond the nuclear fracture region may still be dominated by the ultra-low-matrix permeability restriction of gas drainage from the rock matrix to the natural fractures. This contrasts with the original Gasbuggy concept in which the flow behavior was thought to be dominated by radial flow resistance. The purpose of the nuclear explosion was to create fractures that would extend the effective well radius and thus greatly reduce that flow resistance. (BBB)

Facilities and Equipment

Refer also to abstracts 24380, 24399, 24415, 24418, 24820, 24861, 25240, 25252, and 25282.

24341 (CONF-670649-39) DESIGN OF RADIOISOTOPIC LABORATORIES. Garcia-Orcoyen Tormo, Sergio (Junta de Energia Nuclear, Madrid (Spain). Division de Medicina y Proteccion). [1967]. 7p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

Laboratories with open sources can be divided into three types according to the activity of the source—very high, high, and medium. The various construction aspects with specific characteristics according to the type of laboratory were reported. Some consideration is given to the laboratory installations. Contamination and decontamination are discussed, including limiting values of surface contamination necessary to control the radiation dose to the laboratory workers. (tr-auth)

24342 (CONF-670649-40) UTILIZATION OF THE "NAYADE" IRRADIATION UNIT. Fuente Figuera de Vargas, J. (Junta de Energia Nuclear, Madrid (Spain)). [1966]. 15p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The characteristics of the Nayade irradiation facility are given. The industrial applications of irradiation are tabulated. The institutions and persons using the Nayade irradiation facility between January, 1965, and May, 1967, are also tabulated. (J.S.R.)

24343 (IN-1221) RARE GAS RECOVERY FACILITY AT THE IDAHO CHEMICAL PROCESSING PLANT. Offutt, G. F.; Bendixsen, C. L. (Idaho Nuclear Corp., Idaho Falls). Apr. 1969. Contract AT(10-1)-1230. 47p. Dep. CFSTI.

Radioactive krypton and xenon from spent nuclear fuel reprocessing operations at the Idaho Chemical Processing Plant are removed from off-gases in a cryogenic recovery unit. The process equipment used and experience from several operating periods are described. A method for processing hydrogen-rich off-gas is also presented. (auth)

24344 (LMEC-69-1) LIQUID METAL ENGINEERING CENTER (LMEC). Semiannual Technical Progress Report, July–December 1968. (Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center). Contract AT-(04-3)-700. 281p. Dep. CFSTI.

Progress is reported on the activities of the Liquid Metal Engineering Center (LMEC) in support of the LMFBR development program. Operating and functional requirements for large valves for LMFBR were established. Design parameters for liquid metal pumps were selected. Post operation examination of HNPF valves was continued. Existing and proposed LMEC test facilities and test rigs were evaluated. Draft standards were prepared for the sodium-cooled reactor vessel, circulating cold trap, 100 to 15,000 gpm mechanical free-surface Na pump, an ac electromagnetic Na pump, Na blocking valve, and Na quality. Historical Na reactor failure data were collected and are being evaluated. A microfilm data storage and retrieval system were acquired for storing this data. Development of the Quality Assurance Manual continued. A system was implemented whereby purchase requisitions are reviewed for material quality. Reconstruction of the Sodium Components Test Installation main steam line was continued. The Alco steam generator was opened, inspected, and cleaned. Performance criteria were developed for the Sodium Pump Test Facility (SPTF). A pump envelope was developed for each pump size. To accommodate FFTF pump testing, two alternate design concepts were developed. Cost analysis will determine which design will be used. An analog simulation model was prepared for the main flow loops to determine SPTF system and control transient dynamics. System design descriptions for oil-type and gas-type seal test facilities were approved. A two-step program for developing radial bearings for Na bearing pumps was instituted and a detailed management plan developed. A literature search documenting information on mechanical devices operating in Na was compiled and published. Resultant wear rates are presented for sliding wear tests conducted on 82 material combinations in high temperature liquid and Na vapor; cobalt-base—Ni alloys were found to give the best wear performance. A journal bearing test plan was prepared.

Test conditions are being established for a 2000 hr steady-state run of a steam generator. The capability of computer programs to evaluate pressure, thermal stresses, and vibration of tube sheets was demonstrated. (F.S.)

24345 (MSAR-69-45) DESCRIPTION OF MSAR LOOP 3 TEST FACILITY FOR HIGH-TEMPERATURE MECHANICAL PROPERTIES TEST PROGRAM IN SODIUM. Topical Report No. 12. Kirschler, L. H. (MSA Research Corp., Evans City, Pa.). Mar. 1969. Contract AT(11-1)-765. 56p. Dep. CFSTI.

Design criteria for loops which will lend support to loops 1 and 2 for the investigation of the mechanical properties of structural materials for the LMFBR are presented. The loop is capable of providing a maximum test temperature of 1400°F, maximum Na velocity of 30 ft/sec across the specimen gage length, maintaining a maximum Na purity of <5 ppM O_2, testing at various durations (maximum test time ~3000 hr), and initiating individual tests without affecting the remainder of the tests or the sodium chemistry of the system. Ten units are available for creep-rupture tests. The units have a volumetric flow rate of 8 gpm/unit. This flow rate and a 5 gpm rate from the bypass circuit and oxide control and indicating system (OCI) set the system flow rate of ~85 gpm. The heat source (gas-fired heater) and the heat sink (finned air cooler) were sized from the flow rate. The Na containment material for high temperature Na is 316 stainless steel. Carbon steel and 18-8 stainless steel were used for Na containment at room temperature. (F.S.)

24346 (NYO-3839-5) EXPERIMENTAL INVESTIGATION OF A STEAM-LUBRICATED ROTOR-BEARING SYSTEM; STEADY-STATE LOAD AND STEAM HAMMER INSTABILITY TESTS. Malanoski, S. B.; Orcutt, F. K. (Mechanical Technology Inc., Latham, N. Y.). Jan. 1969. Contract AT(30-1)-3839. 52p. (MTI-68-TR-82). Dep. CFSTI.

Steady-state load performance and steam hammer instability characteristics of the rotor-bearing system with a single-acting thrust bearing (unidirectional thrust load support capability) was obtained. Measurements of the steady-state load capacity and stiffness of the journal bearings and single-acting thrust bearing using both nitrogen and steam as lubricants were made. Conditions are described for onset and suppression of steam-hammer instability of the journal and single-acting thrust bearings operating under realistic environmental conditions. (F.S.)

24347 (NYO-3979-1) ADVANCED HEAT PIPE THERMIONIC TECHNOLOGY. TASK I. DEVELOPMENT OF HIGH VOLTAGE MODULE. Mid-Term Status Report, May 1, 1968-February 28, 1969. Longsderff, R. W. (Radio Corp. of America, Lancaster, Pa.). Contract AT(30-1)-3979. 51p. Dep. CFSTI.

The design of a heat pipe-thermionic module concept capable of output potentials as high as 28 volts was investigated. Technologies required for this module design were developed beyond the state-of-the-art. An advanced Al_2O_3 casting technique was developed for the fabrication of the key insulated tri-layer assembly. Arc suppression coatings were developed for the prevention of voltage arcs in the module due to potentials above the ionization potential of cesium. Fabrication and assembly techniques necessary for the logical development of the high voltage module concept were also investigated. Heat pipe designs capable of transferring the required thermal through-put for high voltage module concepts were also investigated. (auth)

24348 (ORNL-4399) SURVEY OF NUCLEAR REACTOR SYSTEM PRIMARY CIRCUIT HEAT EXCHANGERS. Nelms, H. A.; Segaser, C. L. (Oak Ridge National Lab., Tenn.). Apr. 1969. Contract W-7405-eng-26. 90p. Dep. CFSTI.

Problems resulting from excessive tube vibration in certain primary-circuit heat exchangers in reactor systems were evaluated. Of the 19 reactor systems surveyed, problems in primary exchangers resulting from tube vibration hydrodynamically induced by the shell-side fluid flow were experienced in 9 of the 17 plants that have been operated. The results of a detailed vibration analysis that was based on well-known procedures and information available in the literature supports the general conclusion that if the designs for these exchangers had been critically examined for tube vibration prior to fabrication, and possibility of failure would have been judged too great to accept and the problems could have been averted by design modifications. (auth)

24349 (ORNL-TM-2125) EFFECTS OF STAGE TEMPERATURE DROP ON THERMAL STRESSES IN REPRESENTATIVE CESIUM AND POTASSIUM TURBINES. LaVerne, M. E.; Robin, T. T. (Oak Ridge National Lab., Tenn.). Nov. 1968. Contract W-7405-eng-26. 20p. Dep. CFSTI.

Turbine reference designs for both potassium and cesium systems were analyzed for thermal stresses. Detailed temperature distributions for the rotors were calculated with a finite-difference computer code. Order of magnitude thermal stress estimates indicated that the most severe stresses would occur in the hub region between the first stage rotor and its adjacent bearing in the four-bearing machines, and that these stresses would be well below the 20,000 psi maximum allowable for TZM at 2100°F. Detailed analyses of these components using a code based on the finite element method showed actual thermal stresses in this region of the order of 2000 psi. Order of magnitude estimates for the stators and other components also indicated thermal stresses below the maximum allowable. (auth)

24350 (ORNL-TM-2429) SYSTEM FOR VACUUM TREATMENT AND NITROGEN EQUILIBRATION AT 1200 TO 2000°C. Fitzpatrick, C. M.; Leitnaker, J. M. (Oak Ridge National Lab., Tenn.). Mar. 1969. Contract W-7405-eng-26. 20p. Dep. CFSTI.

An apparatus is described that was designed primarily to provide basic thermodynamic data in the studies of carbonitrides at 1000 to 2000°C at nitrogen pressure from 2 torr to 1 atm. Constant temperature can be maintained in a uniform hot zone during the time of the run at the selected pressure of nitrogen. The sample can be lowered into or raised from the hot zone by a sliding, water-cooled rod. Pressures of nitrogen were measured with a cathetometer and a mercury manometer to better than 0.1 torr. Temperatures were determined using a sight port with a calibrated optical pyrometer on a black body. (auth)

24351 (RFP-1141) CONTINUOUS VIEWING WINDOW. Bowdey, R. Donald; Dahl, William R.; Beno, Richard L. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). Apr. 11, 1969. Contract AT(29-1)-1106. 5p. Dep. CFSTI.

Newly developed devices for use in the operation of vacuum deposition chambers or welding chambers are described. To achieve better operator visibility and to simplify cleaning of view ports, a device was developed which holds a film strip in place by means of spools. The film strip made of Mylar polyester can be easily wound from one spool to another across the chamber window opening permitting operators to manipulate the strip to obtain a clean and clear view whenever necessary during operations. As an accessory to the device, a heat-shield shutter was designed for use with high temperatures or high-rate coatings. The devices can be used for various coating system processes. (auth)

24352 (SC-DR-68-879) TOOLING DEVELOPMENT FOR MACHINING UNFIRED ALUMINUM OXIDE. Myers, J. P. (comp.) (Sandia Labs., Albuquerque, N. Mex.). Jan. 1969. 11p. Dep. CFSTI.

An investigation of the best methods and tools for machining unfired aluminum oxide was made. A grinding wheel is preferred for milling large areas; diamond-tip tools are preferred for all lathe operations; and for drilling, counter-boring, and form machining, extremely sharp fired Al_2O_3 tooling is best. (auth)

24353 (UCRL-50587) SUMMARY OF LRL SOUNDING-ROCKET EXPERIMENTS FROM 1963 THROUGH 1968. Seward, Frederick D. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 12, 1969. 13p. Dep. CFSTI.

Sounding-rocket experiments performed by the Lawrence Radiation Laboratory, Livermore, from 1963 through 1968 are summarized. The results of the flights are given in tabular and graphic form. Also listed are the kinds of rockets used, their motion in flight, the experiments carried, and the success or failure of each rocket and experiment. (auth)

24354 TRANSFER LOCK SYSTEM. Gandolfo, Jean-Marie (to EURATOM). British Patent 1,148,597. Apr. 16, 1969. Priority date June 15, 1965, France.

A transfer lock system used to transfer apparatus, materials and waste between the inside and outside of an enclosed contaminated environment such as a hot cell is described. The system consists of two compartments, one on each side of the enclosure wall. Access openings through the wall into each compartment are aligned with each other. A carrier travels between the two compartments and means are provided for loading and unloading the carrier in the compartments. (F.S.)

24355 METHOD FOR DETERMINING THE OPTIMUM TYPE OF A NUCLEAR ELECTRIC PLANT. Haiduc, C. Stud. Cercet. Energ. Electroteh., 18: 23-36(1968). (In Russian).

Results of research on the development of the optimum type nuclear electric plants are discussed. The competitiveness of nuclear electric plants are compared with thermoelectric power plants. The suggested method envisages four major criteria: specific calculation costs, electric power costs, specific plant investments and nuclear fuel uses. The method also considers a great number of factors governing the profitability of a nuclear

and of thermoelectric power plants. The results of the method advanced are illustrated on 13 nuclear electric power plants and 3 thermoelectric power plants in the actual conditions of Romania. (Rom. Sci. Abstr.)

24356 THE ATOMIC PLANT AT LA HAGUE. IMMINENT STARTING OF INDUSTRIAL PRODUCTION OF PLUTONIUM IN INGOTS. Bull. Belgicatom, 12: 16(July-Oct, 1967). (In French).

This unit was begun in 1962 on the Cotentin peninsula to produce Pu ingots by treatment of irradiated fuels from the Chinon reactors and to assure continuous operation of the Marcoule plant. The geographic situation between Chinon and Brennils led to C.E.A. to choose the site at La Hague; it is also close to Cherbourg, the home port of the first French atomic submarine. The establishment includes plants for production of Pu from the irradiated elements, annexes for administrative and social services, and a power plant. The operation of a nuclear power plant is briefly and simply reviewed. Nearly 1000 workers have worked 4 years on the plant at La Hague; the project emphasizes the progress made by France in the area of its nuclear equipment. (BBB)

24357 MORTAR MODELS OF PRESTRESSED CONCRETE REACTOR VESSELS. Corum, James M.; White, Richard N.; Smith, Jack E. (Oak Ridge National Lab., Tenn.). J. Struct. Div., Amer. Soc. Civil Eng., 95: 229-48(Feb. 1969).

The construction and testing of a small-scale mortar model of a prestressed concrete reactor vessel is described. Attempts were made to determine to what extent small-mortar models and models of elastic materials, such as epoxy, can be used to investigate the stress distributions and the cracking and ultimate failure modes of prestressed concrete reactor vessels. Mortar model designs and fabrication techniques are discussed. Test results for the various steps of the prestressing sequence, for a short creep test period, and for a pneumatic pressure test to failure are presented. Vessel failure was gradual; after extensive concrete cracking, the vessel liner failed with an immediate loss of pressure. The elastic and short-term creep behavior were compared to finite-element analysis predictions. Comparisons were also made with the test results for a second identical mortar model, tested hydraulically, and with the results for a small concrete prototype vessel. From a consideration of the gross complexity of the models, the finite-element analysis techniques provided good prediction of vessel behavior, particularly in the elastic range. Finite-element development work currently underway will extend the analysis capability into cracking and post-cracking behavior. (BBB)

24358 Ge MSAEC G-IIc FAST ANALYZER (Engineering Materials). (Oak Ridge Gaseous Diffusion Plant, Tenn.). (CAPE-1865).

35 drawings.

An analytical system is described for a high speed and versatile method for the simultaneous determination of analytical parameters, such as protein content and enzyme activities, in large numbers of biological samples. Operation is based on rapid readout of the optical transmission of solutions contained in a spinning multi-cuvetted rotor. Fifteen individual-reaction cuvettes can be filled by three separate reactants simultaneously by centrifugally loading them from a transfer disk. Progress of each reaction is monitored optically during each revolution of the rotor. An electrical output is provided. The output may be displayed on an oscilloscope or fed to a computer. (For details see TID-4100 Suppl. 53.) (F.S.)

24359 CAPSULE FOR IRRADIATION OF EXPLOSIVES. Voreck, W. E. (Aerojet-General Corp., Sacremento, Calif.). Nucl. Appl., 6: 582-7(June 1969).

An aluminum capsule 2⅛ in. in diameter and 9 in. long completely contains the high order detonation of 3.6 grams of explosive. This was approved for insertion in the General Electric Test Reactor, and successfully used to irradiate a series of explosive and propellant samples. Modifications were also made to permit continuous measurement of pressure and temperature of the sample during irradiation when desired. Methods used to measure gamma flux, neutron dosages, and temperature limits are also described. (auth)

24360 IMPROVEMENTS IN VELOCITY CONTROL MECHANISMS. (to General Electric Co.). British Patent 1,150,157. Apr. 30, 1969. Priority date Sept. 15, 1965, United States.

A velocity control mechanism is described that can be used in shock absorbers, machine tools, jacks, hoists or in the control of the movement of a reactor control element in the core of a reactor to vary neutron flux and power levels. The relative velocity between a hollow body and a control body reciprocable in the hollow body is controlled by controlling the resistance to relative movement between the two bodies. The hollow body contains a fluid. Relative reciprocation of the body causes fluid flow in the space between the bodies. One of the bodies has a cavity opening into the space between the bodies. The cavity is shaped to divert more fluid into the cavity to generate more turbulence in fluid flow through the space in one direction of relative movement than in the other. (F.S.)

24361 STRESS ANALYSIS FOR REACTOR PRESSURE VESSEL. Hamada, Kunio; Hayashi, Tsutomu (Hitachi Ltd., Tokyo). Hitachi Hyoron, Special Issue, 9-12(Dec. 1968). (In Japanese).

The stress analysis of a Type A 302-B steel pressure vessel for a boiling water power reactor is summarized. The main computer programs for the stress analysis of reactor pressure vessels and the analyses of stresses in shell plate, end plate, flange, nozzle, penetrating part of control rod, core support, and vessel-supporting skirt are explained. (NSA of Japan)

24362 PLUGGING DEVICE. Seki, Katsuzo (to Hitachi Ltd.). Japanese Patent 1969-74. Jan. 6, 1969. Filed Feb. 23, 1966.

In certain types of nuclear reactors the control rod is inserted into the reactor vertically from the bottom. A plugging device is described that is used to plug the hole through which a control rod is inserted when the rod-driving mechanism is repaired or exchanged. The bottom of a reactor vessel is closed with a thick plate; a vertical hole for insertion of a control rod penetrates through the plate. A horizontal hole is cut through the plate in a direction at right angles to the vertical hole, the two holes traversing each other. A horizontal short rod is inserted into the horizontal hole; a hole, at right angles to the rod axis to engage with the (plate) vertical hole, is cut through the rod. The horizontal rod is moved by hydraulic power either to close or to open the vertical hole in the bottom plate. (NSA of Japan)

24363 CAPSULE FOR IRRADIATION TESTS. Hiratsuka, Yasumasa (to Hitachi Ltd.). Japanese Patent 1969-80. Jan. 6, 1969. Filed June 14, 1963.

A method is proposed for testing a variety of pieces in a single capsule. Simultaneous tests, including corrosion, tensile and shock strengths, and radiation damage may be made. Other advantages include the uniform flow of coolant, and easy setting of the test pieces. The capsule includes the capsule wall with many coolant-flow penetrations; horizontal zigzagging wire spacers; and test pieces arranged alternately with the spacers within the capsule. (NSA of Japan)

24364 VARIOUS PROBLEMS CONCERNING THE OPERATION AND CONTROL OF TURBINE FOR ATOMIC POWER. Sakamoto, Tetsuzo (Tokyo Shibaura Electric Co.). Karyoku Hatsuden, 20: 82-98(Jan. 1969). (In Japanese).

The operation and control of nuclear power plant turbines require radiation protection measures, remote automatic operation and control, and special speed governing which is not required for operating conventional thermal power plant turbines. The starting procedure, the normal operation, and the stopping procedure of the turbine in combination with the boiling water-type reactors are explained. The problems concerning operation are detection of the optimum setting of the turning gear when the turbine is stopped, development of the reliable automatic checking method of rubbing, testing of the emergency system in the starting procedure and the normal operation, remote actuation test of the main steam valve, and automatic starting of the turbogenerator. The problems concerning control are prevention of the over-speed due to flushing of remaining drain, development and improvement of reliability of the electric-hydraulic control system, and the setting point of the emergency governor and use of the anticipator. (NSA of Japan)

24365 TEST RIG FOR LIQUID SODIUM TECHNOLOGY. Fujita, Mototsugu; Suzuki, Yasuyuki. Fuji Jiho, 41: 898-902 (Dec. 1968). (In Japanese).

In connection with the domestic development of fast breeder reactors, the test rig for liquid sodium technology was constructed. The operational test was performed in sodium liquid and vapor on the structures used about the movable parts of a reactor. Information for the actual design and construction was obtained. The test rig itself and the results of tests are described. The features of the test rig and test are: test-vessel maximum temperature 600°C; normal temperature 600°C; sodium flow 0.36 m^3/hr (maximum 1.5 m^3/hr); sodium amount 300 kg; in-sodium oxygen concentration 10 ppm; cover gas high-purity argon; piping outer diameter 34 mm and inner diameter 28.4 mm. (NSA of Japan)

Heat Transfer and Fluid Flow

Refer also to abstracts 24348, 26035, 26041, 26044, 26051, and 26124.

24366 (AERE-R-5736) TWO-PHASE TWO-COMPONENT CRITICAL FLOW IN A VENTURI. Smith, R. V.; Cousins, L. B.; Hewitt, G. F. (Atomic Energy Research Establishment, Harwell (England)). Dec. 1968. 54p. Dep. CFSTI. UK 8s. 0d.

The establishment of a functional relationship between the primary flow variables at, and just upstream of, the point of critical or choking flow for a liquid-gas mixture is discussed. The primary variables were pressure, mass flowrate, quality (i.e., ratio of gas mass flow to total mass flow), and the geometry of the flow channel. Experimental and analytical work are reported for air-water flow in a converging-diverging annular venturi with critical and near-critical conditions at the throat. Pressure tappings were placed at regular intervals along the straight outer wall of the venturi and, since the profiled inner core could be moved axially, accurate pressure data could be obtained in the region of the throat where the pressure gradients were very steep. Measurements were made of the flowrate, and thickness and temperature of the liquid film flowing on the outer wall at the venturi. For the analytical treatment, the liquid was assumed to be made up of a film flowing on the outer wall of the venturi and of droplets entrained in the gas stream. The interrelated expressions which describe the behavior of each phase were numerically integrated from the entrance to the throat of the venturi. It was found necessary to introduce a correction factor to the maximum available flow area computed for the gas because the flow pattern information for more detailed study was not available. The value of this factor was determined by trial procedure which set the point of critical flow for the analysis at the same axial position as that observed in the experimental programme. Good agreement was obtained between experimental and analytical results throughout a range of qualities from 0.018 to 1.0, and for two venturis with throat areas differing by a factor of 2. Discussions of critical pressure ratios, fluid velocities and interface transport processes are included. (auth)

24367 (AERE-R-5809) MEASUREMENT OF LIQUID FILM FLOW RATES AT 1,000 psia IN UPWARD STEAM WATER FLOW IN A VERTICAL HEATED TUBE. Bennett, A. W.; Hewitt, G. F.; Kearsey, H. A.; Keeys, R. K. F.; Stinchcombe, R. A. (Atomic Energy Research Establishment, Harwell (England)). Jan. 1969. 12p. Dep. CFSTI. UK 2s. 6d.

The flowrate of the liquid film flowing on the inside wall of a vertical 0.497 in. dia heated tube was measured at 1,000 psia for mass velocities of 2, 1.5 and 1×10^6 lb/hr.ft^2. The results show that as the burnout heat flux is approached the liquid film flow rate decreases smoothly, apparently towards zero at the burnout point at the mass velocities 1 and 1.5×10^6, and towards a very small value at the mass velocity of 2×10^6. (auth)

24368 (ALO-3634-12) RESEARCH AND DEVELOPMENT OF VACUUM FOIL-TYPE INSULATION FOR RADIOISOTOPE POWER SYSTEMS. Quarterly Progress Report, December 1968–February 1969. Carvalho, J.; Dunlay, J. B.; Fronduto, J.; Paquin, M. L.; Poirier, V. L. (Thermo Electron Corp., Waltham, Mass.). Apr. 29, 1969. Contract AT(30-1)-3634. 59p. (TE-4059-154-69). Dep. CFSTI.

Progress on the development of high-temperature thermal insulation for radioisotope power systems is reported. 80-, 120-, and 200-layer Ta–ThO_2 insulation samples were tested under pressures of 2.1 and 5.2 psi. The 200-layer sample was able to limit the transmitted heat flux to .05 watt/cm^2 at 1700°C. This corresponds to a mean thermal conductivity of 9.6×10^{-6} watts/cm°C. The layer variation measurements were continued with 80-, 120-, 160-, and 200-layer samples tested under zero pressure. In addition, two additional groups of reproducibility measurements were initiated and partially completed. A reinforced version of the concentric cup corner assembly was tested. The results represent a considerable improvement over those obtained by testing the original corner. Low temperature 40-layer SS–ZrO_2 data are presented along with preliminary 40-layer Ti–ZrO_2 data and 80-layer SS–ZrO_2 data. (auth)

24369 (CEA-R-3644) THERMAL DIFFUSIVITY OF SOLIDS. Kleimann, Henri; Fetiveau, Yves; Richard, Marc; Eyraud, Lucien; Eyraud, Charles (Institut National des Sciences Appliquees, Lyon (France)); Elston, Jean (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan. 1969. 46p. (In French). Dep.

Methods for making thermal diffusivity measurements and possible causes of errors are discussed. The sinusoidal methods of thermal attack using the measurement of either an amplitude or a phase, in which the controlled energy in-put is obtained either by Joule effect or by radiation was included. By the use of controlled systems, it is possible to apply this method to the measurement of thermal diffusivity of samples over an extended temperature range. Experimental achievements are described and results dealing with Al_2O_3, BeO_4 and MgO are given. (auth)

24370 (CONF-680832-7) HEAT TRANSFER STUDIES TO A WIRE PROBE IMMERSED IN AN ARC PLASMA. Petrie, T. W.; Pfender, E. (Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering). [1968]. 8p. American Society of Mechanical Engineers, New York, N. Y. $1.50.

From 10th National Heat Transfer Conference, Philadelphia, Pa.

Tungsten wires of 0.010 and 0.015 in. dia were swept at constant speed through the column of a 200-amp free-burning arc discharging across a 10-mm gap in argon at atmospheric pressure. The wire probes are floated electrically from the arc plasma and their resistance change is recorded as a function in the arc plasma by means of an oscilloscope. Assuming arc symmetry, a data reduction scheme provides local probe temperatures and heat fluxes. Plasma temperatures are obtained for identical arc conditions from the literature and used with the above probe temperatures and heat fluxes to generate local transfer coefficients averaged around the wire. Heat transfer coefficients obtained for wire positions where the plasma was appreciably ionized are 1 to 3 orders of magnitude larger than those reported for nonionized gas flows owing, primarily, to the effect of deionization reactions in the boundary layer formed around the wire probe and on the wire itself. (auth)

24371 (GEAP-5709) TWO-PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES. Twelfth Quarterly Progress Report, July 1–September 30, 1968. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Nov. 1968. Contract AT(03-4)-189. 31p. Dep. CFSTI.

AIR—air–H_2O, flow in annuli and tubes, entrainment fraction data for
—air–H_2O, flow in low-pressure horizontal channels, measurement of film flow rate and thickness in
FLUID FLOW—structure of adiabatic annular-dispersed two-phase, analysis of entrainment fraction data on
GAS FLOW—velocity profiles for, of air in annular-dispersed round tubes
LABORATORY EQUIPMENT—development for measuring flow rates and film thickness with air-water flow in low pressure horizontal channels
WATER—air–H_2O, flow in annuli and tubes, entrainment fraction data for
—air–H_2O, flow in low-pressure horizontal channels, measurement of film flow rate and thickness in (L.C.L.)

24372 (LA-DC-9786) SUMMARY OF THEORETICAL ASPECTS OF HEAT TRANSFER PERFORMANCE IN CLUSTERED ROD GEOMETRIES. Axford, Roy A. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 51p. (CONF-681103-2). Dep. CFSTI.

From Annual Meeting of the ASME, Los Angeles, Calif.

Theoretical predictions of asymptotic Nusselt numbers and peripheral temperature and heat flux variations on the rod casing wall are summarized for rod cluster geometries for fully developed heat transfer with an axially uniform heat flux. The related hydrodynamic problems for fully developed laminar and turbulent flows are also considered. Single and multiregion models of rod clusters are presented. (auth)

24373 (NYO-3979-2) ADVANCED HEAT PIPE THERMIONIC TECHNOLOGY. Topical Report for Task II. DEVELOPMENT OF ADSORPTION RESERVOIR. Period Covered: May 1, 1968–February 28, 1969. Freggens, R. A. (Radio Corp. of America, Lancaster, Pa.). Contract AT(30-1)-3979. 44p. Dep. CFSTI.

Work performed on the development of an integral adsorption reservoir thermionic converter is described. Three general areas were investigated. These were: cesium purification, material processing, and integral reservoir converter fabrication. The cesium purification employed a high temperature reaction to remove halide compounds from the cesium. The development of a large surface to volume ratio in a molybdenum matrix was studied. Variations in time, temperature, and atmosphere for sintering the matrix were used as the basis of the study. The RCA A-1279 Thermionic Converter was selected as a suitable test vehicle for reservoir evaluation. The design was modified to allow 78 cm^3 of reservoir matrix to be integrally located within the converter. (auth)

24374 (RT/FIMA-(68)6) STUDY OF THE PROBLEM OF HEAT DIFFUSION IN A TEMPORARY REGION OF A MULTI-REGION SYSTEM BY THE METHOD OF INTEGRAL TRANSFORMS. Papa, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 17p. (In Italian). Dep.

The dynamic heat diffusion equations in a multiregion system are analyzed. The mathematical problem is represented by a p.d.e system for the spatial variable x and time variable t. The solution is obtained through weighted average spatial variables, represented by finite integral transform. The kernel of this in-

tegral transform is obtained considering the diffusion operator properties and temperature and flux interface and boundary conditions. (auth)

24375 RADIATION TRANSFER ACROSS A SPHERICAL PORE IN A LINEAR TEMPERATURE GRADIENT. Marino, G. P. (Bettis Atomic Power Lab., West Mifflin, Pa.). Trans. Met. Soc. AIME, 245: 821-3(Apr. 1969).

The conductivity, K_r, of a spherical void in a linear temperature gradient due to radiation is calculated by integration of the general expression for diffuse radiation between two gray surfaces of arbitrary orientation. The spherical geometry allows an exact evaluation of the phenomenon without resorting to approximate expressions for the radiant heat flux. The resulting expression for K_r is three quarters of the approximate value obtained by Loeb. (auth)

24376 HEAT TRANSFER CRISIS UNDER FORCED WATER FLOW AT HIGH PRESSURES. PART I. REPRESENTATION AND ESTIMATION OF THE CRITICAL HEAT FLUX DENSITY AT PRESSURES FROM 170 TO 215 BAR. Herkenrath, H.; Moerk-Moerkenstein, P. (EURATOM, Ispra, Italy). Atomkernenergie, 14: 163-70(May-June 1969). (In German).

A previous report gave detailed results of investigations into the heat transfer crisis in boiling water under forced convection in the pressure range between 170 and 215 bar. These results are presented in the form of synoptic diagrams. They demonstrate above which heat flux density a crisis first occurs, and show the dependence on heat flux density, at the onset of the heat transfer crisis, of the quality, the mass flow density, and the pressure, respectively. An iteration method is supplied for preliminary calculation. (auth)

24377 MEASUREMENT OF HEAT TRANSFER COEFFICIENTS FOR AXIAL AIR FLOW THROUGH ECCENTRIC ANNULUS AND SEVEN-ROD CLUSTER. Tachibana, Fujio; Oyama, Akira; Akiyama, Mamoru; Kondo, Shunsuke (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo), 6: 207-14(Apr. 1969).

The heat transfer characteristics of nonconcentric annuli with various eccentricities and also of a seven-rod cluster were experimentally determined by means of mass transfer technique. A coating of naphthalene was applied to the surface of the test rod and changes in its thickness measured. The mass transfer coefficients were represented in terms of Colburn's j-factor, with which both the average and local values were analyzed. The measured average heat transfer j-factors were found to be in part equal to those for smooth round ducts, but the circumferential variations of the local factors for the eccentric annulus did not agree with the theoretical prediction proposed by Dwyer & Yu. The existence of secondary flow in the seven-rod cluster is also discussed. (auth)

Isotope Technology

Refer also to abstracts 24255, 24338, 24341, 24342, 24368, 24403, 24404, and 24792.

24378 (AERI-21) GAMMA-RAY RADIOGRAPHY BY ^{192}Ir. Lee, Kwan; Hwang, Won Guk (Atomic Energy Research Inst., Seoul (South Korea)). 1968. 172p. (In Korean). Dep.

After the Korean TRIGA M-II reactor became operational in 1962, the industrial application of radioisotopes materialized. Manufacturers have started to use gamma radiation in nondestructive testing. However, no codes and standards for radiography were established in Korea and no guide books are available in Korean. General concepts and procedures required for the nondestructive testing by radiography are given. Some information required for the judgement of the radiographed films is also included. Particular emphasis was made on the nondestructive testing using ^{192}Ir, which is available from the present Korean TRIGA reactor. (auth)

24379 (BNWL-1010) PACIFIC NORTHWEST LABORATORY, DIVISION OF ISOTOPE DEVELOPMENT PROGRAMS QUARTERLY REPORT: NOVEMBER 1968-JANUARY 1969. Drumheller, K. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1969. Contract AT(45-1)-1830. 46p. Dep. CFSTI.

ACOUSTIC EMISSION TESTING—monitoring system for development of portable
AMERICIUM-241—production in light water reactors
CALIFORNIUM-250—production in light water reactors through 1990
CALIFORNIUM-252—production in light water reactors through 1990
HEAT SOURCES—radioisotope production and availability for, review of
LABORATORY EQUIPMENT—development for performing phase studies and property measurements on promethium oxide
NEPTUNIUM-237—irradiation for production of plutonium-238
PLUTONIUM-236—content in plutonium-238, computed and experimental data on
PLUTONIUM-238—production in light water reactors through 1990
—production by irradiation of neptunium-237 in PWR, economic estimates for
PROMETHIUM—preparation and properties of metallic
—purification of, effects of feed dilution on
PROMETHIUM-146—content in reactor-irradiated promethium oxide
PROMETHIUM-147—content in reactor-irradiated promethium oxide
PROMETHIUM OXIDE—phase studies of, description of differential thermal analysis equipment for
—properties of, development of Knudsen cell vapor pressure equipment for measurement of
—dissolution rate in water, counting method for measurement of (L.C.L.)

24380 (CONF-670649-9) FOUR YEARS OF OPERATION OF THE GAMMA RADIATION FIELD OF THE INSTITUTO NACIONAL DE INVESTIGACIONES AGRONOMICAS. Gomez del Campo, Cesar (Instituto Nacional de Investigaciones Agronomicas, Madrid (Spain)). [1964]. 7p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The gamma radiation field of the I.N.I.A. consists of a 2,250 Ci source of ^{137}Cs-^{137}Ba installed in an open field with remote control. It can be used both for acute irradiations of samples of any size or for the chronic irradiation of animals or growing plants. Some technical details of the source and the field itself are given. The existing irradiation programs are outlined. (J.S.R.)

24381 (CONF-670649-10) PREPARATION OF ^{192}Ir SOURCES BY IRRADIATION OF IRIDIUM IN DISCS. de la Cruz Castillo, F.; Jimeno de Osso, F.; Barrachina Gomez, M.; Dominguez Rodriguez, G. (Junta de Energia Nuclear, Madrid (Spain). Seccion de Radioquimica). [1964]. 10p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The preparation of ^{192}Ir sources by the irradiation of Ir discs of small thickness (0.25 mm), separated from each other by a distance of 5 mm, was studied. The discs are placed together after irradiation to form a source. The increase in the radioactivity of the 4 × 4 sources formed of 16 discs of 0.25 mm thickness was greater by a factor of 6 than that of the sources prepared in the usual way. (tr-auth)

24382 (CONF-670649-14) RADIOISOTOPES IN INDUSTRIAL CONTROL. del Val Cob, M. (Junta de Energia Nuclear, Madrid (Spain)). [1966]. 31p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The economic aspects of the use of radioisotopes in industrial instrumentation are analyzed on a global scale. The principles of nucleonic instrumentation and its most important applications are given. The applications cited include thickness gages, analysis of materials, and measurement of the level of solids and fluids. The present utilization of nucleonic instrumentation in Spain is summarized. Future possibilities are indicated. (J.S.R.)

24383 (CONF-670649-15) UTILIZATION OF ISOTOPES IN CONSTRUCTION PROBLEMS. IV. DETERMINATION AND CONTROL OF RADIATION LEAKS IN SHIELDED ENCLOSURES BY THE USE OF RADIOACTIVE ISOTOPES. Dequidt, E.; San Martin, M. V. (Junta de Energia Nuclear, Madrid (Spain). Division de Metallurgia). [1967]. 12p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The procedure followed to determine the integrity of the shielding of a hot cell with the capacity of handling 1,000 Ci of 1 Mev γ radiation is described. (J.S.R.)

24384 (CONF-670649-17) PRODUCTION AND CONSUMPTION OF RADIOISOTOPES IN SPAIN IN 1965 AND 1966: PAPER OF THE JUNTA DE ENERGIA NUCLEAR. Dominguez, G.; del Val Cob, M. (Junta de Energia Nuclear, Madrid (Spain)). [1967]. 30p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The production and consumption of radioisotopes in Spain during the biennium 1965 to 1966 has maintained the expansive evolution previously shown. The activities of the JEN in the production of

radioactive materials and in the development of applications are summarized. The production and consumption of individual radioisotopes in 1965 to 1966 have tabulated. (J.S.R.)

24385 (CONF-670649-18) ISOTOPIC ENERGY GENERATORS. Dominguez, G. (Junta de Energia Nuclear, Madrid (Spain)). [1967]. 40p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

Energy generators have been developed within the past few years which use radioisotopes either as primary sources of energy or in direct conversion methods. The development of these types of generators is outlined. The methods used for the conversion of radioactive decay energy are described. Specific areas for the application of isotopic energy generators are reviewed. (J.S.R.)

24386 (CONF-670649-41) UTILIZATION OF RADIOACTIVE ISOTOPES IN CONSTRUCTION PROBLEMS. III. DETERMINATION OF INTERNAL CONSTRUCTION DEFECTS IN THE 1000 MeVCl METALLURGICAL CELL. Fuentes Figuera de Vargas, J. (Junta de Energia Nuclear, Madrid (Spain)). [1967]. 19p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The experiments carried out to determine the leak points in the protection walls of a hot cell before it was placed in service were described in detail. (J.S.R.)

24387 (MLM-1634(tr)) CONCENTRATION TO HIGH LEVELS OF HEAVY OXYGEN (^{18}O) BY THE THERMAL DIFFUSION METHOD. Yamamoto, M.; Takahashi, M.; Imaoka, M.; Hashikoka, T.; Hirota, K. Translated for Mound Lab., Miamisburg, Ohio, from Nippon Kagaku Zasshi, 89: 839-43(1968). 28p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 47300. (auth)

24388 (MMM-3321-19) DEEP SEA RADIOISOTOPE-FUELED THERMOELECTRIC GENERATOR POWER SUPPLY SYSTEM. SNAP-21B PROGRAM, PHASE I. Final Summary Report. Benson, D.; Panneman, R.; Yanisch, V. Jr. (Minnesota Mining and Mfg. Co., St. Paul. Isotope Power Lab.). June 1966. Contract AT(30-1)-3321. 266p. Dep. CFSTI.

EQUIPMENT AND PROCEDURES—design and testing of SNAP-21 auxiliary and power conditioning
FUEL CAPSULES—design, fabrication, and testing of SNAP-21
PRESSURE VESSELS—design, fabrication, and testing of SNAP-21
SHIELDING—design, fabrication, and testing of molybdenum–uranium alloy SNAP-21
SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP-21)—thermoelectric generator for, design, fabrication, and testing of 10W
THERMAL INSULATION—design, fabrication, and testing of SNAP-21
THERMOCOUPLES—design and testing of SNAP-21
THERMOELECTRIC CELLS—design, fabrication, and testing of 10W SNAP-21 (R.C.K.)

24389 (MMM-3824-33) SNAP-23A PROGRAM, PHASE I. THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM. Monthly Report, February 1969. (Minnesota Mining and Mfg. Co., St Paul. Electrical Products Group). Mar. 15, 1969. Contract AT(30-1)-3824. 42p. Dep. CFSTI.

Design efforts were continued to finalize the design of the converter electrical interface for SNAP-23A. Inconel 625 is the preferred material for the converter outer case on the basis of its inherent resistance to corrosive attack in all anticipated SNAP-23A environmental conditions. The preferred material for the heat source, stud jacket, and converter hot frame is Type 304 stainless steel. Test data evaluation and analysis were performed on the following long term test devices: No. 2 (EMC-2), No. 3 (EMC-3), No. 1B (PMC-1B), 10-Couple Modules 1 and 3 and 5 through 12, 6-Couple Module 23A3, and converter 23P2. Structure and enclosure design activities for PMC-2 continued. The instrumentation requirements were established. With the change of enclosing structural materials to Type 304 stainless steel and Inconel 625, weld development plans were prepared. (F.S.)

24390 (NP-tr-1744) RADIOISOTOPES IN SPAIN: THEIR APPLICATIONS AND CONSUMPTION IN 1965–6, AND THE ROLE OF THE JUNTA DE ENERGIA NUCLEAR. Dominguez, G.; Del Val Cob, M. Translated by C. R. Brightmore (Atomic Energy Research Establishment, Harwell, Eng.), from Energ. Nucl. (Marid), 11: 389-400(1967). 24p. Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 14728. (L.C.L.)

24391 (TE-3858-1) STUDY ON AN IMPLANTABLE POWER SOURCE FOR CIRCULATORY SUPPORT DEVICES. (Thermo Electron Corp., Waltham, Mass.). Nov. 1, 1968. Contract AT-(30-1)-3858. 552p. Dep. CFSTI.

Studies and the conceptual design of a radioisotope-powered Rankine-cycle engine which will serve as the power source for an implantable circulatory support system are described. The studies include an evaluation of candidate radioisotopes, parametric analysis of Rankine cycle performance, blood heat exchanger design, operation of control system, selection of thermal energy storage material, and packaging in vacuum-foil thermal insulation. The fundamental requirements of the implantable power source are high efficiency, reliability and small size. The study included not only the design of the power supply, but also its coupling to the blood pump. Considerable effort was also devoted to the evaluation of control techniques which allow efficient utilization of the available hydraulic power by the blood pump. The basic concept of the circulatory system is illustrated. The heat comes from radioactive decay of plutonium-238. The radioisotope inventory is minimized by using thermal energy storage. Heat is "stored" in the form of thermal energy by melting a eutectic mixture of lithium halide salts. Stored thermal energy is recovered by solidifying the molten salt, producing steam in the process. Mechanical energy is extracted from the steam by expansion in the engine and is used to pump hydraulic fluid (water) into the high-pressure reservoir. Water from the high-pressure reservoir is used to drive the blood pump. Control of pumping rate and volume, and efficient coupling are accomplished by the hydraulic coupling and control element interposed between the blood pump and the high-pressure reservoir. The circulatory support system components are incorporated into three separate packages. The power source, which includes the thermal energy storage material, the engine, and the high-pressure reservoir, will be located in the abdominal cavity and attached to the ilium or another large skeletal bone. The coupling and control element will be located in the abdominal cavity below the diaphragm. The third package is the blood pump located in the chest. Hydraulic lines connect these packages and transmit power and heat. The power source weighs 2.2 kg, has a volume of 900 cc, and is fueled by plutonium-238. It provides an average of 4 W of hydraulic power output and a peak output of 12 W. These characteristics result in a power source of acceptable size and weight which can perform the required function within acceptable physiologic limitations on reject heat. The engine efficiency for the reference design is expected to be 62.5%. This performance has been demonstrated in laboratory tests in engines of only twice the bore of the proposed engine. Maintaining this performance level in the smaller engines is a major problem. Thermal losses are minimized by reducing the cylinder wall thickness and strength is obtained by using a glass filament winding. Mechanical friction losses are reduced by avoiding the use of bearings in the transmission of the main power output of the engine: the power piston is connected directly to the hydraulic pump piston. The power source characteristics are suitable for a circulatory support device. The heat source design is similar to that demonstrated with the thermal energy storage prototype. A large number of small engines have been operated at 900°F steam inlet temperature, including a test run of over 3000 hours. The calculated thermal-to-shaft efficiency of 20% represents a modest improvement over measured efficiencies (17.6%) already achieved in engines of only twice the bore of the reference design. The additional endogenous heat load of 18 W (average) should be well within the body's ability to dissipate. Since the reference design power source is based on relatively straightforward extrapolation of existing technology, it offers considerable potential for further improvement in performance, size, and weight. Therefore, the implantable Rankine-cycle radioisotope power source is considered to be feasible for driving a circulatory support device. (R.C.K.)

24392 ATOMIC ENGINEERING. CHAPTER I. Ind. At., 13: 23-76(1969). (In Italian).

The annual tabulation of nuclear engineering and nuclear economy in Europe is presented. Tables are given on the availability of ores, metals, and fuels; nuclear power plants in operation or under construction; properties of materials and nuclear fuels; radioelements; sealed sources available at the C.E.A.; properties of radiations; accelerators with more than 1 BeV power; and conversion of current units into Giorgi units. (J.S.R.)

24393 DEVELOPMENT OF A THERMIONIC GENERATOR HEATED WITH ^{227}Ac. Gammel, G. (Brown, Boveri und Cie, AG, Mannheim, Ger.); Koskinen, M. F.; de Troyer, A. Raumfahrtforschung, 13: 1-4(Jan.-Feb. 1969). (In German).

The development status of a radioisotopic device is described which uses actinium-227 as a heat source and a thermionic converter. The power output is in range of 20 to 100 W. The

design concept is described and measurements of the electrical performance using a prototype are discussed. (auth)

24394 THE INFLUENCE OF THE DISTRIBUTION OF ATOMIC MASSES WITHIN THE MOLECULE ON THERMAL DIFFUSION. II. ISOTOPIC METHANE AND METHANE/ARGON MIXTURES. Stevens, G. A.; De Vries, A. E. (FOM-Instituut voor Atoom en Molecuulfysica, Amsterdam). Physica, 39: 346-60(Aug. 26, 1968).

The temperature dependence of the thermal diffusion factor for several isotopic mixtures of methane and mixtures of argon and methane was studied in two swing separators between 80°K and 300°K. The isotopic mixtures showed a noticeable influence of the mass-distribution within the molecule, whereas a description with a Lennard-Jones potential remained still possible. These mixtures could be classified roughly into two categories, one with a potential well depth of 190 to 196°K, the other with one of 223 to 225°K. The first consisted of mixtures of spherical top molecules with zero difference in the moments of inertia, the second of mixtures of molecules with different moments of inertia. From the comparison between theoretical and experimental results it is concluded that viscosity is not seriously affected by the presence of inelastic collisions, while diffusion and thermal diffusion would give smaller and larger ϵ-values, respectively, if described by the Chapman-Enskog theory. For all studied mixtures of methane and argon the inversion temperature was found to be 137.5°K. A concentration reversion in these mixtures gave an unexpected small change of the thermal diffusion factor. Inelastic collision between argon and methane are probably much less important than those between two methane molecules. (auth)

24395 A RADIOACTIVE THERMAL POWER SOURCE AND METHOD OF MAKING SUCH A SOURCE. (to Sanders Nuclear Corp.). British Patent 1,148,549. Apr. 16, 1969. Priority date Mar. 20, 1967, United States.

A method for preparing a radioactive heat source with good heat conductivity is described. A mixture of molecules of a refractory metallic compound, such as thulium oxide, and metal atoms of thulium is compacted, sintered, and irradiated. When irradiated, the isotopes ^{170}Tm and ^{171}Tm are formed. Hot or radioactive materials are not handled during fabrication. (F.S.)

24396 GENERATOR. (to Nuclear Materials and Equipment Corp.). British Patent 1,148,703. Apr. 16, 1969. Priority date Dec. 14, 1966, United States.

An electric power generator for use in space or remote locations where commercial power is not available is described. The generator consists of a radioactive heat source fueled with ^{60}Co, ^{238}Pu or ^{90}Sr and a heat-to-electricity converter which is in heat exchange relationship with the capsule. The capsule is enclosed in a biological shield. The converter consists of one or more electric modules having a hot junction thermally connected to a heat rejection system. A support structure is provided for the capsule, heat shield, modules, and heat rejection system. (F.S.)

24397 SOME APPLICATIONS OF RADIOACTIVE ISOTOPES IN METALLURGY. Bergner, D. Freiberg. Forschungsh., B, 132: 107-30(1968). (In German).

A review of the fields in which radioactive tracers can be applied in metallurgical investigation is presented. Bulk diffusion, grain-boundary diffusion, and diffusion as a factor in oxidation processes are discussed in detail and the technique of autoradiography is described. (Metals Abstr.)

24398 APPLICATION OF RADIO NUCLIDES. Waechter, Karl Heinz (Frieseke and Hoepfner GmbH, Erlangen, Ger.). VDI (Ver. Deut. Ing.) Z., 111: 178-82(Feb. 1969). (In German).

The quantity and value of radioisotopes used in West Germany during 1965 to 1968 are tabulated. Descriptions are given of the various applications which include radiometry and radiography, activation analysis, irradiation techniques, tracer techniques, and uses as sources in isotopic batteries for heart pacing machines and satellites. (L.C.L.)

24399 A RESONANCE SELF-INDICATION TECHNIQUE FOR ISOTOPIC ASSAY OF FISSILE MATERIALS. Menlove, H. O.; Tesche, C. D.; Thorpe, M. M.; Walton, R. B. (Los Alamos Scientific Lab., N. Mex.). Nucl. Appl., 6: 401-8(Apr. 1969).

A resonance self-indication technique to measure nondestructively the thickness of fissile materials has been investigated. This method utilizes the resonance structure in the neutron fission cross section by passing an epithermal beam of neutrons through the sample and then to thin fission detectors that are sensitive to the resonance absorption lines in the transmitted flux corresponding to the resonance reaction peaks. The measurements included samples of ^{233}U, ^{235}U, and ^{239}Pu with thicknesses ranging from 5 to 270 mils. The present measurements indicate that this technique could be used to measure the thickness of ^{239}Pu with an accuracy of 1 to 3%, and an accuracy of 2 to 10% for ^{233}U and ^{235}U for thicknesses <150 mils. The influence of extraneous material in the samples was greatly reduced by using ratios of different fission detectors in the measurement. Computer calculations of the fission rates were made, and the theoretical results are in good agreement with the measurements. (auth)

24400 AEROSOL RESEARCH AT THE JOHNS HOPKINS SCHOOL OF HYGIENE. Swift, David L.; Proctor, Donal F. (Johns Hopkins Univ., Baltimore). J. Air Pollut. Contr. Ass., 18: 675(Oct. 1968).

Use of ^{99m}Tc to study the efficiency of water aerosols to the lower respiratory airways is reported. The water aerosols were produced by jet and ultrasonic nebulizers of a type commonly used in aerosol therapy. The water was tagged, prior to nebulization, with the isotope. Postexposure scans indicated that under normal nasal or mouth breathing between 75 and 95% of the aerosol mass is removed in the upper respiratory airways, e.g., above the larynx. The calculated daily delivery of water droplets to the lower respiratory airways ranges from 5 to 40 ml. In nasal breathing experiments essentially all particle deposition occurred in the anterior uncliated nares. Studies of the nature of flow in models of human nasal passages are also described. The production of ^{99m}Tc-tagged monodisperse oil aerosols for spatial deposition distribution experiments is another area of research effort was accomplished by a modified LaMer generation in which the condensation nuclei contain the radioisotope. These aerosols could be produced over a wide size range (0.5-5μ) and the pattern of deposition and clearance is to be studied using an Anger camera. (BBB)

Materials Testing

Refer also to abstracts 24363, 24783, 24810, 24859, 24860, 24949, 25755, and 26146.

24401 (ARH-1058) EVALUATION OF INERTIA WELDING FOR HIGH LEVEL WASTE ENCAPSULATION. Wormeli, John C. (Atlantic Richfield Hanford Co., Richland, Wash.). Mar. 1969. Contract AT(45-1)-2130. 19p. Dep. CFSTI.

The encapsulation of high-level solid radioactive wastes requires both an inner and outer metal container, each sealed with a leak-tight, pressure-proof, welded joint. The advantages of inertia welding for joining these containers are described. Ultrasonic inspection of test welds, confirmed by subsequent metallurgical and mechanical testing, revealed the test welds to be of high quality. It is concluded that inertia welding is especially suitable for this use, and should be tested further. (L.C.L.)

24402 (BNWL-1012) ULTRASONIC VELOCITIES AND CRITICAL-ANGLE-METHOD CHANGES IN IRRADIATED 304 STAINLESS STEEL. Hunter, D. O. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1969. Contract AT(45-1)-1830. 48p. Dep. CFSTI.

Ultrasonic critical-angle-method amplitude changes and ultrasonic shear and longitudinal velocities changes were measured on reactor irradiated AISI 304 stainless steel. For specimens irradiated at temperatures between 140 and 350°F, shear velocity decreased from about 0.1% at 1.5×10^{18} nvt > 1 MeV to about 1.25% at 1×10^{20} nvt > 1 MeV; longitudinal velocity decreased from about 0.1% to 0.5% for the same neutron fluences. Measurements of velocities changes for specimens irradiated at temperatures between 610 and 680°F were inconclusive due to the small changes. There were indications, however, that high temperature irradiated specimens had experienced increased velocities before decreasing velocities trends were established. The trends of critical-angle-method amplitude changes, as functions of irradiation parameters, were generally comparable to the trends of velocities changes. Apparent changes in elastic constants were calculated by using measured changes in density and in shear and longitudinal velocities. Measurement methods and apparatus are described. (auth)

24403 (CONF-670649-19) UTILIZATION OF RADIOISOTOPES IN INSTALLATIONS OF THERMAL POWER PLANTS. Pla Forcat, A.; Velando Pedrol, E. [1967]. 13p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The gammagraphic testing of the welds in large thermoelectric power plants is a construction technique now in increasingly wide use. The factors to be considered in the selection of the gamma-

graphic cameras and types of film to be used are discussed. The installations at the Badalona II power plant which were tested by gammagraphic methods are outlined in illustration. The accessibility of the points to be controlled, the rapidity of operation, and the camera weights are discussed with particular reference to the Badalona II power plant. The gammagraphic installation used and the measurement methods are described. (J.S.R.)

24404 (CONF-670649-31) GAMMAGRAPHY AND THE NONDESTRUCTIVE TESTING OF MATERIALS. Delojo Morcillo, Gabriel (Instituto Nacional de Tecnica Aerospacial, Madrid (Spain)). May 10, 1967. 20p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The application possibilities of gammagraphy for the nondestructive testing of materials are reviewed. The most common methods of nondestructive testing are described, and the factors to be considered in the selection of a method are discussed. The advantages and disadvantages of x and γ are compared. (J.S.R.)

24405 (LA-DC-9760) RESONANCE SELF-INDICATION TECHNIQUE FOR ISOTOPIC ASSAY OF FISSILE MATERIALS. Menlove, H. O.; Tesche, C. D.; Thorpe, M. M.; Walton, R. B. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 30p. (CONF-681101-24). Dep. CFSTI.

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C.

A resonance self-indication technique was developed to nondestructively measure the thickness of fissile materials. This method utilizes the resonance structure in the neutron fission cross section by passing an epithermal beam of neutrons through the sample and then to thin fission detectors that are sensitive to the resonance absorption lines in the transmitted flux corresponding to the resonance reaction peaks. The measurements included samples of ^{233}U, ^{235}U, and ^{239}Pu with thicknesses ranging from 5 to 270 mils. The present measurements indicate that this technique could be used to measure the thickness of ^{239}Pu with an accuracy of 1 to 3%, and an accuracy of 2 to 10% for ^{233}U and ^{235}U. The influence of extraneous material in the samples was greatly reduced by using ratios of different fission detectors in the measurement. Computer calculations of the fission rates were made, and the theoretical results are in good agreement with the measurements. (auth)

24406 (LA-DC-10050) RADIOGRAPHIC INSPECTION OF HOT REACTOR FUEL ASSEMBLIES USING THE 22-MeV BETATRON. Elliott, D. E.; Torbert, J. F. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 23p. (CONF-690305-5). Dep. CFSTI.

From Remote Handling and Examination in the Fast Reactor Field Meeting, Idaho Falls, Idaho.

Radiographic techniques for the inspection of radioactive reactor fuel assemblies have been developed and applied over the past six years. The 22 MeV Allis–Chalmers Betatron was proven an excellent source for this radiography. It has the necessary small emitting surface, radiation output and radiation energy. This radiography has been valuable not only in providing information about the condition of the assembly but also as a guide for its subsequent destructive examination. The procedure produces better radiographic resolution than has been developed in neutron radiography but cannot be used on assemblies with as high gamma activity. (auth)

24407 (ORNL-4384) SOME EDDY-CURRENT PROBLEMS AND THEIR INTEGRAL SOLUTIONS. Dodd, C. V.; Luquire, J. W.; Deeds, W. E.; Spoeri, W. G. (Oak Ridge National Lab., Tenn.). Apr. 1969. Contract W-7405-eng-26. 89p. Dep. CFSTI.

Integral representations were obtained for the vector potential produced by a circular coil for a number of different geometrical configurations. From the vector potential any observable electromagnetic induction phenomenon can be calculated. The present solutions are limited to cases with axial symmetry and linear media. The solutions are in the form of multiple integrals of ordinary and modified Bessel functions. The configurations that were solved include coils with rectangular cross sections in the following locations: above or on each side of a two-conductor sheet bounded by parallel planes, between two parallel-plane conductors, encircling a tube or a rod consisting of one metal clad on another, and inside a tube. The electromagnetic phenomena that were calculated include the coil impedance, the phase and amplitude of the voltage induced in pickup coils, the effects of small spheroidal defects on the impedance and phase, and the forces generated in a metal by the eddy currents. The agreement between calculated and measured phenomena is excellent in most cases and within experimental error in all cases. (auth)

24408 (ORNL-4390, pp 177-88) NONDESTRUCTIVE TEST DEVELOPMENT. Harms, W. O.; McClung, R. W. (Oak Ridge National Lab., Tenn.).

New techniques and equipment for the nondestructive evaluation of materials and components are being developed. The major emphasis has been on eddy-current, ultrasonic, penetrating radiation, and holographic methods. Analytical work on electromagnetic phenomena has been directed in part to the solution of problems related to tubing inspection. Curves relating flaw sensitivity to inspection variables such as the thickness of the tubing wall and coil configuration and dimensions were developed. Procedures were improved for making miniature probe-coil assemblies. An improved immersion tank and specimen-handling devices were fabricated and assembled for the ultrasonic schlieren system. Continued investigations of frequency analysis include observation of the effects of impedance-matching circuitry on the frequency spectra of transmitted pulses, study of the effect of flaw size on the frequency spectra of reflections from rear surfaces, development of a method for digital display of the integrated intensities of preselected frequency spectra, and development of improved circuitry to achieve better ratios of signal to noise, which will allow measurements on much smaller signals. Computer programs have been developed to aid in graphically plotting data from x-ray attenuation and radiographic densitometry studies. An unfocused collimator with goniometer capability has been constructed for gamma-ray scattering studies using multichannel analysis of energy spectra. (auth)

24409 IMPACT STRENGTH TESTING IN REACTOR ENGINEERING. Tutschek, E.; Koss, P. (Reaktorzentrum, Seibersdorf, Austria). Kerntechnik, 11: 26-30(Jan. 1969). (In German and English).

The experimental techniques of impact strength testing in reactor engineering are substantially affected by the alterations of the brittle fracture behavior of structural materials caused by reactor radiation. The importance of brittle fracture in the development of reactor construction materials is outlined. The techniques of impact strength testing of unirradiated and of irradiated structural materials specimens under ideal conditions are reviewed. It is shown that this does not necessarily require a special materials testing reactor and that an ordinary research reactor without special hot cells can also be used for the study of the changes of the mechanical properties of materials owing to irradiation in a reactor. The practical use of the results of impact strength tests is illustrated on the example of a calculation of the transition temperature of a reactor pressure vessel. (auth)

24410 IMPROVEMENTS IN TESTING THE REGULARITY OF EDGES AND APPARATUS THEREFOR. Blackham, Leslie Redvers; Thompson, William; Jackson, James William (to United Kingdom Atomic Energy Authority). British Patent 1,148,063. Apr. 10, 1969. Filed July 26, 1965.

In the manufacture of UO_2 fuel elements the UO_2 is formed into cylindrical pellets which are rather fragile and whose edges are prone to chipping. Visual inspection is time consuming, and the object of the method described is to provide an improved and generally applicable method for examining edges. The principle of the method is to test the edge by making it a seal between a high pressure region and a region of substantially lower pressure within a housing and determining the effectiveness of the seal, and hence the regularity of the edge, by detection of any leakage. The required apparatus is described and illustrated. The system may be automated, including means for rejection of unsatisfactory pellets. (UK)

24411 MECHANICAL PROPERTIES AND NONDESTRUCTIVE MONITORING OF WELDS IN 2,5 PERCENT Nb–Zr HIGH STRENGTH TUBES USING THERMOELECTRIC POTENTIAL MEASUREMENTS. Musso, G.; Volta, G. (CCR–EURATOM, Ispra, Italy). Ing. Nucl., 9: No. 4, 23-8(July-Aug. 1968). (In Italian).

Results of tests useful for evaluating local mechanical properties of welded zones in Zr-Nb 2,5 tubes are presented. Two welding procedures are examined: TIG and electron-beam. Destructive mechanical tests are described together with a non-destructive check based on thermoelectric potential measurements which gives indications correlated with the structure and therefore with the local properties of the material. (auth)

Radioactive Material Handling

Refer also to abstracts 24305, 24354, and 24401.

24412 (ARH-SA-30) RADIOACTIVE WASTE MANAGEMENT POLICIES AND PRACTICES. Smith, P. W.; Hanson, G. L. (At-

lantic Richfield Hanford Co., Richland, Wash.). Apr. 2, 1969. Contract AT(45-1)-2130. 42p. Dep. CFSTI.

The development of radioactive waste management practices at Hanford is discussed. The effects of power reactors and reprocessing plants on waste management is summarized. Radioactive waste management policies which guide the atomic energy industry and waste management practices currently being used are described. The program at Hanford is emphasized and a brief review of the overall industry and probable future trends are presented. The Code of Federal Regulations for Protection against Radiation and licensing and packaging of radioactive materials is reviewed. Disposal and storage methods for gaseous; low-intermediate-, and high-level liquid; and solid wastes are given. (F.S.)

24413 (BNWL-SA-1952) RADIOACTIVE WASTE LOCATION VIA INFRARED SCANNING TECHNIQUES. Jensen, J. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 3, 1968. Contract AT(45-1)-1830. 5p. (CONF-681101-22). Dep. CFSTI.

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C.

When a sluice mining operation is used to remove radioactive waste materials which have been stored in large underground tanks, it is necessary to determine the location and quantity of residual waste sludge which will require additional sluicing for complete waste removal. An infrared scanning technique was developed to locate concentrations of radioactive sludge in waste storage tanks. The method is based on the fact that the heat generated in a given area of a storage tank is proportional to the amount of radioactive sludge present. The infrared energy emitted is detected by the scanner, and the detected signals are electronically processed to provide a display map of the sludge locations. If the tank background temperature does not exceed 80°C, the system is capable of resolving a 1 ft^2 area on the bottom of a 75 ft dia storage tank if the temperature of the area differs from the background by 3°C or more. If a calibration heat source is available in the tank, the system can also be used for absolute temperature measurements. (L.C.L.)

24414 (KY-550) DEMONSTRATION FUEL ELEMENT SHIPPING CASK FROM LAMINATED URANIUM METAL. PART I. GENERAL INFORMATION, BACKGROUND, AND DESIGN. Loveland, C. W.; Stitt, D. H.; Bernstein, S. (Paducah Gaseous Diffusion Plant, Ky.). Apr. 15, 1969. 94p. Dep. CFSTI.

A demonstration fuel element shipping cask that uses laminated uranium metal as the shielding material was designed, fabricated, and tested. The background of the program, general information concerning pertinent chemical and physical properties of uranium related to its use for shielding applications, and the design and engineering phases of the project are discussed. A complete set of the design drawings of the cask is also included. The overall project demonstrated the feasibility of using laminated uranium metal for radioactive material shipping casks. (auth)

24415 (NYO-841-16) HARVARD AIR CLEANING LABORATORY SEMIANNUAL PROGRESS REPORT, SEPTEMBER 1, 1968-FEBRUARY 28, 1969. Underhill, D. W.; First, M. W.; Grubner, O.; Reist, P. C.; Moeller, D. W. (Harvard Univ., Boston, Mass. Harvard Air Cleaning Lab.). Apr. 1969. Contract AT(30-1)-841. 13p. Dep. CFSTI.

Research on air cleaning processes are reported. A review of the probable characteristics of Na aerosol particles and the extent to which they will be altered was made to evaluate a post-accident ventilating cleanup system for the Fast Flux Test Facility. Mathematical equations were developed for computing the gas temperature within a cleanup system following an accidental release and burning of Na coolant in the containment volume of the FFTF assuming the facility is equipped with a cleanup system containing a pebble bed heat sink. A FORTRAN program was developed for calculating the deposition of particles from turbulent flow onto a pipe wall. Experimental studies show that thermophoresis plays a dominant role in wall deposition of hot Na particles from flowing gas streams. Experimental data are being analyzed to quantitatively distinguish the deposition arising from thermal gradients and that arising through inertial effects. The effectiveness and operating characteristics of asbestos precoated cleanable industrial bag filters for removing Na are being investigated. An attempt to verify a theoretical treatment of dynamic adsorption using the statistical moments theory was made. An expression for calculating breakthrough time of adsorption beds and the influence of changes in experimental conditions were found. Changes include alteration in particle size, porosity, carrier gas velocity, nature of adsorption, and bed length. (F.S.)

24416 NEEDLE-GRIPPER FOR ENGAGING AND TRANSPORTING HOLLOW TUBULAR ELEMENTS. Wilhelem, Antoine; Rathat, Elie (to EURATOM). British Patent 1,149,456. Apr. 23, 1969. Priority date May 26, 1966, Belgium.

A device that enables a tubular element, such as reactor fuel element, in an inaccessible enclosure to be engaged, by means of a traveling crane or other remote handling equipment is described. The device retains the tubular element during transportation and later deposits the element in a vertical position. (F.S.)

24417 FLASK FOR CONVEYING RADIOACTIVE PRODUCTS. Brisac, Michel; Cazalis, Jean-Pierre; Lefort, Guy (to Commissariat a l'Energie Atomique). British Patent 1,148,816. Apr. 16, 1969. Priority date Oct. 11, 1966, France.

A shielded container for transferring radioactive waste contained in a waste bin is described. The container may be connected to a hot cell without interrupting the alpha and gamma shielding. The container consists of an outer casing containing a mass of heavy material such as lead, an opening for the waste bin which can be loaded either vertically or horizontally from the hot cell, and a method for closing. The closure moves transversely to the chamber axis to close the container. The closure member has a key with partially cylindrical end faces which fit into the space taken up by the waste bin. The key has a number of roller elements running in grooves formed parallel to the direction of the container top. The key is adapted to about a matching stationary key on the hot cell shielding. A dome is provided for the key to be used in transfer. (F.S.)

24418 RADIOACTIVE MATERIALS TRANSPORT CONTAINER. Motomiya, Kimio (to Hitachi Ltd.). Japanese Patent 1969-79. Jan. 6, 1969. Filed Aug. 19, 1966.

A transport container for radioactive materials is described that is designed to prevent rupture of the outer metal casing when lead in the container is melted in a fire accident. A vacuum space in a suitable shape, e.g., with corrugation, is made within the lead shield to absorb the expansion of the molten lead. (NSA of Japan)

Vacuum Engineering

Refer to abstract 24491.

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 26134.

General Detectors and Monitors

Refer also to abstracts 24318, 25652, 25742, and 25743.

24419 (AD-679027) CRITICAL CURRENT CHARACTERISTICS OF SUPERCONDUCTING THIN FILM PARTICLE DETECTORS. Miklosz, John C. Jr. (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). Aug. 1968. 55p. (NDL-TR-111). CFSTI.

A brief review of the experimental and theoretical work of Spiel and Boom and of Sullivan on superconducting nuclear particle detectors is presented. Their thermal diffusion model has been improved and solutions for the dynamic behavior of thermal spikes in thin superconducting films have been obtained so that the treatment of the critical current characteristics of the detectors in the absence of joule heating is now substantially complete. It appears that some important features of the behavior of thermal spikes in thin films cannot be understood on the basis of classical thermal diffusion calculations alone. The applicability of the thermal diffusion model is considered and the effects which may make the approach inadequate are discussed. (auth) (USGRDR)

24420 (CEA-CONF-1232) NUCLEAR DETECTORS: PHOTOMULTIPLIERS, COUNTERS, IONIZATION CHAMBERS. Roguin, Andre; Weill, Jacky (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1968. 15p. (In French). (CONF-680642-7). Dep.

From International Conference on Electronics and Automation, Herceg Novi, Yugoslavia.

An account is given of recent work on nuclear detectors other than semiconductor detectors. This review allows one to determine the recent possibilities of these types of detectors and gives a survey of future development. Neutron-electron converters, counters with a boron deposit, recoil proton counters, fission chambers, G-M and proportional counters, and photomultipliers are described. (J.F.P.)

24421 (CEA-CONF-1233) SEMICONDUCTOR DETECTORS OF NUCLEAR PARTICLES. Messier, Jean (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). June 1968. 24p. (In French). (CONF-680642-6). Dep.

From International Conference on Electronics and Automation, Herceg Novi, Yugoslavia.

The physical principles on which are based the operation of semiconductor detectors are reviewed. Also the most important problems in the construction and use of these detectors are discussed. (J.F.P.)

24422 (CEA-R-3702) AUTOMATIC COUNTING AND RECORDING UNIT USED FOR DATING BY THE ^{14}C METHOD. Albertinoli, Pierre; Galliot, Jean; Thommeret, Jean (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires. Centre Scientifique de Monaco, Monte Carlo). Jan. 1969. 59p. (In French). Dep.

A description is given of the unit used by the Centre Scientifique de Monaco for low-level beta counting and fitted for radioactive dating by the carbon-14 method. Built entirely by the laboratory in 1964, on the basis of electronical technics then recent, it has worked without failure since that time. The proportional counter, its high-voltage negative supply, and the counting chains with visual and printing records are detailed by means of 38 figures which reproduce the counter and the electronic circuits. These are contained in two standard 5 U I chassis. The low-voltage power supply of the whole unit is carried out by plus 12 volts and minus 12 volts storage batteries, buffered on a charger connected on the 110 V alternative line. The proportional counter described is filled with CO_2 under one atmosphere pressure and permits the dating of carbonaceous samples with a maximum of 30,000 ± 1,000 years (background 3.96 c.p.m.) within a moderate time (72 hours). (auth)

24423 (CEA-tr-R-1942). NUCLEAR EMULSIONS FOR ELECTRON AUTORADIOGRAPHY. Ryabova, R. V.; Samoilovich, D. M.; Senchenkov, E. P.; Chentsov, Yu. S. Translated into French from Zh. Nauch. Prikl. Fotogr. Kinematogr., 12: 217-18(1967). 8p. (In French). Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 21: 41209. (W.H.K.)

24424 (CONF-670649-43) LIQUID SCINTILLATOR APPLIED TO THE DETERMINATION OF ATMOSPHERIC SAMPLES. Celma Villares, M. (Junta de Energia Nuclear, Madrid (Spain). Division de Medicina y Proteccion). May 1967. 14p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The determination and measurement of ^3H in the form of tritiated water by means of the determination of the HTO content in rain water were described. The measurement equipment, consisting of a three-channel liquid scintillation detector with five discrimination levels, the low-temperature detection system, and the automatic sample exchanger, is described. The background of the samples, the effect of temperature, and the efficiency for various isotopes were determined. The efficiency for ^3H in HTO is a function of the water concentration in the sample. The optimum measurement conditions, according to the nature and activity of the sample, were established. The values obtained for the ^3H activity in the rain water in Madrid in 1964-1967 in monthly samples were reported and compared with the global evolution of the atmospheric activity. (tr-auth)

24425 (IFA-MR-30) THE VALUATION OF THE TOTAL ABSOLUTE EFFICIENCIES FOR NaI(Tl) CYLINDRICAL AND WELL-TYPE CRYSTALS. Ionescu, Constantza (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). 1968. 8p. Dep.

The efficiency of the cylindrical and well-type crystals NaI(Tl) was estimated by means of some analytical formulas given. The source was considered placed somewhere on the crystal axis for the cylindrical crystals and in the bottom of the well for the well-type crystals. Two calibration curves were also calculated for a well-type 6 × 6 cm. Quartz and Silicon crystal and a cylindrical 4.5 × 5 cm. Tesla crystal. Good agreement with several efficiency data existing in literature was obtained. (auth)

24426 (IN-1218, pp 181-316) EXPERIMENTAL FACILITIES, TECHNIQUES, AND INSTRUMENTATION. (Idaho Nuclear Corp., Idaho Falls).

ADVANCED TEST REACTOR—operation of, description of computer-driven oscilloscope display for systems readout during
BETA SPECTROMETERS—design of magnetic $\pi\sqrt{2}$
—resolution of lithium-drifted silicon, for conversion electrons
COMPUTERS—drum handlers and drum monitor for PDP-9
—data display system for PDP-9
—interfaces for on-line general purpose
CONTROL SYSTEMS—description of generalized computer-based
DATA ACQUISITION SYSTEMS—description for thermal neutron scattering cross section experiments
—description of generalized computer-based
DATA PROCESSING SYSTEMS—development of computer-based, at NRTS
ENGINEERING TEST REACTOR—fuel elements for, use of cobalt-60 as radioactive tag for assay of boron content in
—effluent water from, development of procedure for using lithium-drifted germanium spectrometer for monitoring
—effluent water from, comparison of results from radiochemical analysis and spectroscopic analysis of
FISSION PRODUCTS—gamma ray spectra of gross, effects of decay time on
GAMMA SPECTROMETERS—calibration of lithium-drifted germanium, gamma standards for
—development of Compton summing, with lithium-drifted germanium detectors
—data analysis for lithium-drifted germanium, computer
GAMMA SPECTROSCOPY—equipment for analysis of lunar samples, computer-based
HYDRAULIC PRESSES—design of 100-kbar, for neutron diffraction studies
MATERIALS TESTING REACTOR—effluent water from, development of procedure for using lithium-drifted germanium spectrometer for monitoring
—effluent water from, comparison of results from radiochemical analysis and spectroscopic analysis of
NEUTRON SPECTROMETERS—design and performance of proportional proton-recoil
—data processing system for proportional proton-recoil, block diagram of on-line computer
NEUTRONS—capture by nuclei, measurement of gamma ray intensities from

—reactions (n,γ) with iron, absolute gamma ray intensities from
PULSE CONVERTERS—calibration and performance of analog-to-digital
RADIATION DETECTORS, ACTIVATION—calibration procedure for beta counting of uranium-aluminum fission rate
RADIATION DETECTORS, SEMICONDUCTOR (GERMANIUM)—efficiency and resolution of lithium-drifted, for gamma spectroscopy
—field increment effect in lithium-drifted
—pulse rise-time rejection system for lithium-drifted
RADIATION DETECTORS, SEMICONDUCTOR (SILICON)—resolution of lithium-drifted, for x-ray and conversion electron spectroscopy
—performance of lithium-drifted, for x-ray fluorescence spectroscopy
REACTOR FUEL ELEMENTS—burnable-poison content in ETR, use of cobalt-60 as radioactive tag for assay of boron
REACTOR FUELS—fission products from uranium-235, gamma ray spectra as a function of time for gross
REACTORS—effluent water from, development of procedure for using lithium-drifted germanium spectrometer for monitoring
REACTORS, RESEARCH—design of Repetitively Pulsed Test Facility, use of combined 3-10 MW sodium cooled plutonium fueled reactor and charged particle neutron source for conceptual
—design of Coupled Fast Reactivity Measurement Facility, qualitative description of
—neutron flux spectra for Coupled Fast Reactivity Measurement Facility, calculated real and adjoint
—converter tube for Advanced Reactivity Measurement Facility, calculated real and adjoint neutron flux spectra for uranium oxide (UO_2)
REACTORS, TEST—neutron fission rate monitors for, calibration procedure for automatic gross beta counting of uranium-aluminum
REACTORS, THERMAL—neutron fission rate monitors for, calibration procedure for automatic gross beta counting of uranium-aluminum
X-RAY FLUORESCENCE ANALYSIS—method and equipment for, using lithium-drifted silicon detectors
X-RAY SPECTROMFTERS—resolution of lithium-drifted silicon (M.L.S.)

24427 (KURRI-TR-13) CALIBRATION OF THE RADIOACTIVE WASTE-LIQUID MONITOR. Saito, Naohiro; Nerai, Teruhiko; Tsujimoto, Tadashi; Yoshii, Giichi; Katsurayama, Yukinori (Kyoto Univ. (Japan). Research Reactor Inst.). [Mar. 19, 1966]. 23p. (In Japanese and English). Dep.

The characteristics of the radioactive liquid wastes monitor, installed at the waste disposal facility of the Kyoto University Reactor Research Institute, were determined. The results indicated that the monitor has a sensitivity of 1×10^{-6} μCi/ml with respect to 0.5 MeV β particles; thus, the instrument is able to detect the permissible concentration where the waste liquid, with an average concentration over 8 hour period of 1×10^{-7} μCi/ml, not including ^{226}Ra and ^{228}Ra, is released outside. Therefore, concentration by solidification and other methods must be used. The monitor consists of a water sampler, G-M counter with 30-mg/cm^2 window and counting circuit. The tubes are arranged in two groups of five in the sampler which is shielded from external γ radiation by a 5 cm thick lead sheet. The counting circuit consists of a preamplifier, discriminator, anticoincidence circuit, and coincidence circuit. A radioactive standard prepared from ^{90}Sr was used to calibrate the system. (TTT)

24428 (LA-DC-9761) HIGH EFFICIENCY NEUTRON DETECTORS FOR NUCLEAR SAFEGUARDS APPLICATIONS. East, L. V.; Walton, R. B. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 5p. (CONF-681101-20). Dep. CFSTI.

From International Conference on the Constructive Uses of Atomic Energy, Washington, D. C.

Two designs of polyethylene-moderated neutron detectors utilizing multiple helium-3 proportional counters with matched responses are described. (B.G.D.)

24429 (LAL-1211) SHORTENING OF DETECTOR SIGNALS WITH PASSIVE FILTERS FOR PILE UP REDUCTION: CALCULATIONS AND EXPERIMENTAL. Amsel, G.; Bosshard, R.; Zajde, C. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). Feb. 1969. 70p. Dep.

A method is described for the shortening of particle detector signals. Unipolar pulses may be obtained of duration shorter than that of the physical phenomenon taking place in the detector. Iterative passive filters of the bridged T type are used, yielding a constant resistive impedance (for example 50Ω – 50Ω). The transfer function of such a filter may approximate, to within a constant factor, the inverse of the transfer function equivalent to the output of the detector. The design and the very simple construction and use of such filters are described, and numerous results are shown. Thus for a 56 AVP photomultiplier and a plastic scintillator the width at 10% of the maximum of the signal is reduced from 17.5 ns to 8.5 ns. NaI(Tl), anthracene, and semiconductor detectors are also considered. (auth)

24430 (SZS-18/68) NEUTRON PROBE IN CONNECTION WITH THE RADIOMETER VA-J-05 FOR RADIATION PROTECTION MEASUREMENTS. Steuer, J.; Kiesewetter, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Dec. 1968. 20p. (In German). Dep.

Design and characteristics of an instrument for the measurement of neutron dose-equivalent rate in radiological protection are described. The instrument is provided by combining an Andersson–Braun type moderator assembly with a commercially available beta-gamma radiometer. A corona proportional counter with a boron layer on the cathode is used as detecting instrument for thermal neutrons. The gamma to neutron sensitivity ratio is at least 1 : 2000 at gamma levels up to 50 R/h. (auth)

24431 (TUBIK-9) RADIATION MEASUREMENT TECHNIQUE. Wesser, U.; Metzger, L.; Krenzer, H. W. (Technische Universitaet, Berlin (West Germany). Institut fuer Kerntechnik). May 1968. 288p. (In German). Dep.

These lecture notes are to be used for preparation of experimental course at the Lehrstuhl und Institut für Kerntechnik at the Technical University Berlin. They shall give students basic knowledge on radiation and application of equipment for measurements. The covered items are: radioactivity; interaction of neutrons with matter; α, β, and γ radiation; radiation protection; detectors; error statistics; and examples of radiation measurements. (auth)

24432 (UCRL-50007-68-2, pp 8-20) THE DETECTION OF CHERENKOV LIGHT FROM RADIOACTIVE SOURCES IN WATER. Wilson, A. E.; Tinney, J. F.; Koch, J. J. (California Univ., Livermore. Lawrence Radiation Lab.).

Theoretical and experimental aspects of detection of neutron-, gamma-, and beta-emitting radioactive sources underwater by Cherenkov light are discussed. The background radiation encountered in seawater is examined. The basic electronic equipment used for detection of Cherenkov light is described. Temperature effects on the photomultiplier tubes were investigated. Preliminary data are presented. (B.G.D.)

24433 (UCRL-50007-68-2, pp 20-4) OPTIMIZATION STUDIES FOR THE FIDLER DETECTOR. Lindeken, C. L.; Koch, J. J. (California Univ., Livermore. Lawrence Radiation Lab.).

Results of an investigation of the relative responses of a 2-in.-diameter NaI(Tl) crystals 1/16, 1/8, 1/4, 1/2, 1, and 2 in. thick for detection of 17-, 60-, and 185-keV × radiation are presented. (B.G.D.)

24434 (UCRL-50007-68-2, pp 24-31) CALIBRATION OF AN X-RAY SENSITIVE PLUTONIUM DETECTOR. Tinney, J. F. (California Univ., Livermore. Lawrence Radiation Lab.).

A calibration procedure for an x-ray sensitive plutonium detector is presented which takes into consideration the following: the isotopic composition of the plutonium contaminant, the thickness and composition of any overburden material, the influence of other radioactive materials that may be present, the size of the contaminated area, the characteristics of the radiation detector, and the source-to-detector geometry. (B.G.D.)

24435 (UCRL-50007-68-2, pp 34-40) A PORTABLE ^3H MONITOR USING A LARGE AREA, THIN WINDOW PROPORTIONAL COUNTER. Block, S.; Hodgkins, D. J.; Taylor, R. D. (California Univ., Livermore. Lawrence Radiation Lab.).

A large-area, thin-window, gas-flow proportional counter was developed which will be made into a portable system whose lower limit of detection will be 1 MPC of HTO. It does not require an external pump since diffusion of gas in the atmosphere surrounding the counter provides the sample to be counted. (B.G.D.)

24436 (UCRL-50007-68-2, pp 43-6) TRITIUM DETECTION USING A CaF_2(Eu) SCINTILLATOR. Prevo, C. T.; Santomassimo, V. C. (California Univ., Livermore. Lawrence Radiation Lab.).

A CaF_2(Eu) scintillator has been utilized to develop a system capable of detecting low levels of tritium in non-laboratory environments. (auth)

24437 (UCRL-50007-68-2, pp 46-50) INSTRUMENTATION FOR THE DETECTION OF ^{85}Kr AND ^3H IN NATURAL GAS PRO-

DUCING WELLS. Prevo, C. T.; Santomassimo, V. C. (California Univ., Livermore. Lawrence Radiation Lab.).

A system which has been given the name STALLKAT (System to Analyze Low Levels of Krypton and Tritium) and consists of a gas-flow ^{85}Kr proportional counter and a $CaF_2(Eu)$ tritium scintillation detector is described. (B.G.D.)

24438 (UCRL–50007-68-2, pp 58-63) ADVANCE WARNING SYSTEM FOR DETECTING ^{41}Ar BUILDUP IN ENVIRONMENTAL AIR. Lindeken, C. L.; Anderson, A. L. (California Univ., Livermore. Lawrence Radiation Lab.).

A system based on simultaneous measurements made on the roof of the Wholebody Counting Building and within the counting room for determining advance warning of high ^{41}Ar concentrations is described. (auth)

24439 (UCRL–50007-68-2, pp 63-4) SHOE MONITOR FOR LOW ENERGY BETA EMITTERS. Greenhouse, N. A. (California Univ., Livermore. Lawrence Radiation Lab.).

A shoe monitor using a large-area, thin-window Geiger-Mueller counter for low-energy beta detection is described. (B.G.D.)

24440 (UJV–2148-F) PREPARATION OF THIN FILMS. Vobecky, M.; Dragoun, O. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Feb. 1969. 12p. Dep.

Techniques for the preparation of thin films for use as Geiger-Mueller counter windows and as supports for radioactive sources are described. Materials studied include nitrocellulose, copolymer of vinylchloride and acetate, polystyrene, polyamide, polyvinylacetate, and polyvinylbutyrate. (W.H.K.)

24441 INSTRUMENT FOR MEASURING ACTIVITY PER UNIT LENGTH OF ELONGATED RADIATION EMITTING BODY. Duvalet, Gilbert Charles Theophile. British Patent 1,147,833. Apr. 10, 1969. Priority date Apr. 27, 1966, France.

An apparatus is described which permits direct instantaneous readings of activity per unit length of radioactive wires. (B.G.D.)

24442 APPARATUS AND METHOD FOR IONIZATION DETECTION. (to Micro-Tek Instruments Corp.). British Patent 1,148,440. Apr. 10, 1969. Priority date Oct. 18, 1965, United States.

An apparatus is described for determination of ionization characteristics of certain gases which comprises a radiation source and detector. This apparatus is similar to electron-capture detection used in gas chromatography. (B.G.D.)

24443 SCANNING AND RECORDING MEANS. Leiter, Harry. British Patent 1,145,088. Mar. 12, 1969. Priority date Apr. 6, 1965, United States.

A radioisotope scanner is described which provides means for processing and permanently storing data in a recoverable form. (B.G.D.)

24444 A Ge(Li)–NaI(Tl) SYSTEM FOR GAMMA–GAMMA ANGULAR CORRELATION MEASUREMENTS. Hrastnik, B.; Ljubicic, A.; Vojnovic, B.; Ilakovac, K.; Jurcevic, M. (Inst. Ruder Boskovic, Zagreb). Fizika (Zagreb), 1: 127-36(1969).

A Ge(Li)–NaI(Tl) system for coincident and directional gamma-gamma angular correlation measurements is described. The system was checked by measuring the lifetime of the 0.482 MeV level in ^{181}Ta by the delayed coincidence method and by measuring the anisotropy for the 1.172–1.332 MeV cascade gamma transition in ^{60}Ni. The results are in very good agreement with previous measurements. (auth)

24445 METHANE FLOW COUNTER FOR RAPID EVALUATION OF EXOELECTRON DOSIMETERS. Engelland, W. PTB Mitt., 79: 15-19(Feb. 1969). (In German).

The exolectron emission can be used for the preparation of dosimeters for ionizing radiation in personnel dosimetry. An apparatus is described for evaluating the thermally stimulated exoelectron emission (TSEE). It consists of a methane-flow point counter and a heating device. A special transport device for the dosimeters and a fixed temperature of 260°C for stimulation lead to relative short evaluating time of 40 s. The device covers a dose range of about three orders of magnitude. The used exoelectron dosimeters consist of a mixture of beryllium oxide and graphite powder and allow dose measurements in the range from 0.03 to 60 R. (auth)

24446 NEW METHOD OF COMPARING THE PERFORMANCE OF NEUTRON MONITORS. Martinelle, Sten (Univ. of Uppsala). Ark. Geofys. 5: 437-47(1969).

A one-factor model is used to compare neutron monitor data from different stations. The method supplies information about the performance of the stations in a concise form allowing for differences in cut-off rigidities. (auth)

24447 COMMENTS ON IN-CORE FLUX DETECTOR. Stringer, J. L.; Dau, Gary J. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. Nucl. Appl., 6: 422(May 1969).

In a recent article by W. H. Todt (Nucl. Appl. 5: 173(1968)) an in-core detector was described. It is shown how additional data can be obtained with the same detector. As pointed out by Todt, the vacuum-chamber detector displays asymmetry in applied voltage vs. current plots for both thermal neutron flux and photon fields. The straight-forward analytical treatment presented indicates how both neutron- and photon-flux components in a combined field can be measured with the detector. (auth)

24448 GAS SCINTILLATION. REVIEW. Somorjai, Endre. ATOMKI (At. Kut. Intez.) Kozlem., 10: No. 3, 45-61(Dec. 1968). (In Hungarian).

Upon passage through gases, charged particles give off some of their energy, transferring it to the particles of the gas. The energy thus obtained is in turn emitted by the atoms, molecules or ions of the gas, generating light during this process. This gas scintillation may be also achieved by other means. Because of their very long wavelengths, rare gases are used in gas scintillation counters. The first practical counter was built by C. Eggler and C. M. Huddleston; it was operated in conjunction with a photoelectron multiplier. The actual mechanism of the scintillation phenomenon has not yet been completely clarified. The photons are generated by inelastic collisions, in which atoms in the ground, excited or ionized states, electrons and photons interact with each other. Study of excited levels resulted in the identification of three levels: the optical, the resonance and the metastable one. The radiative recombination plays an important role in the mechanism of the luminescence of rare gases. The recombination probability cannot be neglected, if strongly ionizing particles, such as fission products are used for excitation. (Review article, 28 references). (TTT)

24449 NEUTRON DETECTORS FOR NUCLEAR REACTORS. Kobayashi, Kazuo (Mitsubishi Electric Corp., Tokyo). Mitsubishi Denki Giho, 43: 323-8(Feb. 1969). (In Japanese).

Discussions are made herein on the construction, various characteristics and related problems of a gamma compensated ionization chamber (CIC) and a ^{10}B-lined proportional counter developed by Mitsubishi as neutron detectors for nuclear reactors. Particularly in regard to the compensation characteristics of CIC, studies have been made on the difference between the degree of compensation when calibrated by the use of ^{60}Co and that obtained when actually equipped to a reactor. Brief reports are also made on the results of continuous operation tests made with a research reactor. (auth)

24450 RADIOASSAY FOR β-EMITTERS IN BIOLOGICAL MATERIALS USING CHERENKOV RADIATION. Laeuchli, Andre (Univ. of California, Davis). Int. J. Appl. Radiat. Isotop., 20: 265-70(Apr. 1969).

An investigation was conducted on the detection of β-emitting radionuclides in plant roots by means of Cherenkov radiation. The samples were directly radioassayed in polyethylene vials using an aqueous solution of the wavelength shifter 7-amino-1,3-naphthalene-disulfonic acid. High efficiencies were obtained for hard β-emitters, e.g., about 60% for ^{86}Rb in 1 g tissue. The relatively weak β-emitter ^{36}Cl can be determined with an efficiency of 13 percent in plant roots. The maximum β-energy of a nuclide must be at least 0.5 MeV for radioassay by Cherenkov radiation in biological material. Self-absorption of weak β-emitters in tissues must be considered. The procedure described should also be applicable to other plant tissues and to animal materials. The method was tested in experiments on the kinetics of ion absorption by plant roots and earlier work in which radioactivity was determined with a gas-flow counter was confirmed. (auth) (UK)

24451 SMALL ANIMAL AND INFANT LIQUID SCINTILLATION COUNTER. Graham, E. R. (Univ. of Missouri, Columbia). Contract AT(11-1)-1064. Int. J. Appl. Radiat. Isotop., 20: 249-54(Apr. 1969).

The performance and calibration of a small animal or infant liquid scintillation counter are described. With this instrument it is possible to measure the total amount of potassium in an animal or an infant which contains 10–12 g of potassium with an accuracy of 4% at 1 standard deviation or at 8% for 2 standard deviations for a counting time of 15 min. (auth) (UK)

24452 DEVELOPMENTS IN NUCLEONIC COUNTING. Davies, R. G. Electron. Equip. News, 48-51(Apr. 1969).

A review is presented of in vivo and in vitro counting techniques

in connection with medicine and the life sciences, including the single-channel gamma spectrometer, the modular single-channel system, the cost of multichannel ratemeter systems, medical scintiscanners, gamma cameras, etc. (UK)

24453 QUENCH CORRECTION BY THE GAIN RATIO METHOD AND COMPENSATION OF THE ACTIVITY DEPENDENCY ON SCINTILLATOR VOLUME. Kaczmarczyk, N.; Ruge, I. (Technische Hochschule, Munich). Int. J. Appl. Radiat. Isotop., 20: 283-93(Apr. 1969). (In German).

The fundamentals of the gain ratio method, a modified pulse height shift method, are described. The gain and discriminator settings are explained with regard to minimal statistical error of the calculated activity. A theoretical requirement is derived for the complete compensation of the activity dependency on scintillator volume. This compensation formula was experimentally verified. (auth) (UK)

24454 NEW PHENOMENON TO BE TAKEN INTO CONSIDERATION WHEN INVESTIGATING PHOSPHORESCENCE BY LIQUID SCINTILLATION METHOD. Fodor-Csanyi, P.; Levay, B. (Eoetvoes Lorand Univ., Budapest). Int. J. Appl. Radiat. Isotop., 20: 223-8(Apr. 1969).

While investigating phosphorescence radiation in the measurement of low-energy β-emitters by liquid scintillation methods a new group of phenomena was observed. In the presence of scintillator molecules the phosphorescence of the bottle, of the solvent and of the additives increased. This phenomenon called the introduction of phosphorescence may influence the choice of the optical filter and the scintillator decisively, and necessitates a phosphorescence investigation of every individual component in the presence of the scintillator molecule. (auth) (UK)

24455 SEMICONDUCTOR DETECTORS. Bertolini, G.; Coche, A. (eds.). New York, John Wiley and Sons, Inc., 1968. 526p. $22.50.

The characteristics and applications of semiconductor radiation detectors are discussed. Topics include fundamental properties of semiconductors, characteristics and construction of detectors, electronics for energy measurements and the time resolution, nuclear radiation spectroscopy and search for semiconductor materials for gamma-ray spectroscopy. (B.G.D.)

24456 DETECTOR FOR EXACT MEASUREMENT OF CHARGED PARTICLES COORDINATES. Lorikyan, M. P. (Erevan State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz., 3: 146-7(1968). (In Russian).

An apparatus is described for measuring the coordinates of high-energy charged particles with an accuracy of 10 to 30 microns. The apparatus operates by the charged particles passing through an emitter producing secondary electrons which are then accelerated under the influence of a homogeneous electric field to a luminescent screen. (B.G.D.)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 25715.

24457 (CEA-CONF-1250) DOUBLE TIME-OF-FLIGHT SPECTROMETER WITH MULTIPARAMETRIC ANALYSIS. Technical Note PhN-68/C-5T. Perrin, C.; Bouchez, R.; Quivy, P.; Gondrand, J. C.; Giorni, A.; Pouxe, J.; Cremet, J. P.; Perrin, P. (Grenoble Univ. (France). Laboratoire de Physique Nucleaire. Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). May 1968. 6p. (In French). (CONF-681208-11). Dep.

From Conference on Experimental Methods in Nuclear and Particle Physics, Strasbourg, France.

The three nucleon reactions D(n,nnp) has been studied at 14 MeV using an automatic system for collection of data (≈1 true event by minute, $\approx 10^4$ events total). For each event seven parameters were recorded on paper tape. The nn and np interaction parameters were obtained by analysis off-line on an IBM 7044 computer. (auth)

24458 (EUR-3940-1, pp 129-58) NUCLEAR CHEMISTRY LABORATORY CONTRIBUTION TO NUCLEAR DETECTION. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center).

Radiation spectroscopy equipment and methods are described including alpha, beta, gamma, and x-ray spectrometers. Investigations of the timing properties of fast photomultipliers and the development of low-noise electronic devices are discussed. The development of semiconductor detectors is outlined. Also, neutron spectroscopy research for neutron shielding experiments and burnup determinations is summarized. (W.H.K.)

24459 HIGH-RESOLUTION GAMMA SPECTROMETRY WITH LITHIUM-DRIFTED GERMANIUM DETECTORS. PART 2. Bueker, H. (Kernforschungsanlage, Juelich, Ger.). Kerntechnik, 11: 39-45(Jan. 1969). (In German and English).

A description of the basic electronic components of lithium-drifted germanium gamma spectrometers is presented including the preamplifier, the linear amplifier, and the multi-channel analyzer. Also, the use of germanium gamma spectrometers in neutron activation analysis and fission products investigations is outlined. (W.H.K.)

24460 USE OF SEMICONDUCTOR DETECTORS IN ACTIVATION ANALYSIS. Bertolini, G. (Joint Nuclear Research Center, Ispra, Italy). Kerntechnik, 11: 31-5(Jan. 1969).

A description of the physical phenomena governing the detection process in a Ge(Li) counter is given. The detection efficiency and the peak-to-background ratio are discussed for different detector volumes and for special configurations. In particular the optimization of the energy resolution of the detector plus associated electronics is analyzed. Finally the application to activation analysis is discussed for what concerns analytical sensitivity and high purity analysis. Future trends in this field are presented. (auth)

High Energy Physics Instrumentation

Refer also to abstract 25722.

24461 (CERN-Trans-68/16) ON THE POSSIBILITY OF MEASURING THE IONIZATION CAPACITY OF A PARTICLE IN A SPARK CHAMBER WITH SMALL GAPS. Agan'yants, A. O.; Leksin, G. A.; Tiunchik, V. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). Translated into French by A. Golovanoff (CERN, Geneva), from report ITEF-603. 11p. (In French). Dep.

Here are presented some quantative data on the relation between the ionization capability of the particle and characteristics of the photograph image of the spark belonging to the correspondent track in a spark chamber with small gaps. The possibility to measure the ionization density by the comparison of characteristics of the particle spark and ones of the special standard spark initiated simultaneously in the same discharge gap is considered. (auth)

24462 (JINR-P13-4369) SHOWER EFFICIENCY OF SPARK CHAMBERS. Kopeliovich, B. Z.; Pisarev, A. F.; Saraikin, A. I.; Sheshunov, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1969. 15p. (In Russian). Dep.

The shower efficiency of spark chambers, having the dimensions 135×145 cm^2 with the gap from 1 to 5 cm, is experimentally investigated. The minimum gap, at which high shower efficiency is conserved, is in the range between 1.5 and 2 cm. The efficiency of the chambers (with 2 cm gap) for simultaneous detection of 1-8 particles, depending on the magnitude of a clearing field and the momentum delay time, is studied in detail. (auth)

24463 (SLAC-Trans-94) TECHNOLOGY OF BUILDING LARGE-SIZE SPARK CHAMBERS AND HIGH-CURRENT PULSE GENERATORS FOR THEIR SUPPLY. Baicher, K. A.; Zykin, Yu. N.; Nikanorov, V. I.; Nozdrin, I. Kh.; Pisarev, A. F.; Pisarev, V. F.; Tolstoi, N. S.; Filippov, V. N.; Sheshunov, V. M. Translated for Stanford Linear Accelerator Center, Calif., from report JINR-P13-4191. 19p. Dep. CFSTI.

The design of large spark chambers and the associated pumping and filling are described. A new solution has also been found for making reliable high-voltage high-current pulse generators capable of supplying such chambers. (auth)

24464 ULTRASONIC HELIUM BUBBLE CHAMBER. Brown, R. C. A.; Hilke, H. T.; Rogers, A. H. (CERN, Geneva). Ultrasonics, 7: 93(Apr. 1969).

There is an interest in the use of an ultrasonic standing wave system to provide the expansion required in a bubble chamber; one main advantage is the possibility of a high repetition rate. A brief description is given of a small helium chamber at CERN, in which ultrasonic expansion can be tested in particle beams. Using the carefully tuned chamber, operating at 100 kHz, bubbles along tracks of minimum ionizing pions and protons, in the temperature range 3.4 to 3.65°K, were observed to grow to visible size (100 μ) within 600 μsec and the bubble intensity along the tracks was typically 8 to 10 bubbles/cm. (UK)

24465 COMPUTER GRAPHICS: TECHNIQUES AND APPLICATIONS. Parslow, R. D.; Prowse, R. W.; Green, R. E. (eds.). London, Plenum Press, 1969. 261p. 80s.

A section is included on high energy physics applications, under the following headings: Interactive graphics at CERN; generation and measurement of artificial bubble chamber events; analysis of spark chamber events rejected by automatic measurement systems; on-line mathematical analysis; potential applications of graphics; and requirements for hardware and software. A section is also included on graphical output in a research establishment, with emphasis on the Culham Laboratory of the UKAEA. (UK)

Radiation Dosimeters

Refer also to abstracts 24212 and 24219.

24466 (AD-677373) COBALT BOROSILICATE GLASS GAMMA DOSIMETRY AND ITS USE AT THE US ARMY NUCLEAR DEFENSE LABORATORY. Stuetzer, Max; Gibson, Nancy N. (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). Sept. 1968. 25p. (NDL-TM-47). CFSTI.

A description of the cobalt borosilicate glass gamma dosimetry system used by the US Army Nuclear Defense Laboratory is presented. Cobalt borosilicate glass is an inexpensive, efficient, and reliable passive dosimeter for a range of gamma exposures. The use of energy discrimination shields provides the system with an almost flat photon-energy response from 60 keV to 10 MeV, and thermal neutron shields eliminate 99.9 percent of the thermal neutron fluence. The main problems associated with the system are fast neutron corrections, fading, saturation effects, and variations in plate parameters. (auth) (USGRDR)

24467 (AD-679028) EXPOSURE-RATE RESPONSE OF SELECTED GAMMA DOSIMETERS. Gibson, Nancy N.; Crimmins, Thomas W.; Jacobson, John R. (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). Aug. 1968. 55p. (NDL-TR-114). CFSTI.

Exposure-rate and total-exposure effects on the response of various gamma dosimeters were investigated by means of a flash X-ray machine. The dosimeters studied were manganese-activated calcium fluoride microthermoluminescent dosimeters (MicroTLD), lithium fluoride (MicroTLD), cobalt-activated borosilicate glass and silver-activated metaphosphate glass. Dosimeter responses are given. (auth) (USGRDR)

24468 (KFK-825) THE ACCURACY OF PERSONNEL DOSIMETER READINGS: A CRITICAL REVIEW OF INTERCOMPARISON MEASUREMENTS. Piesch, E. (Kernforschungszentrum, Karlsruhe (West Germany)). Dec. 1968. 27p. Dep.

The results of intercomparison test exposures with film, TLD, and RPL dosimeters are reviewed. To discuss the measuring accuracy attainable today by routine personnel dosimeters the measuring accuracy will be described exactly by the distribution curve of the dose reading deviations related to the actual dose. Instead of the term standard deviation normally used, two different values are ascertained here to compare the results of different test exposures: the relative number of exposures found within a dose reading deviation of ±30% and the dose reading deviation found for 85% of all test irradiations (15% outliers). A careful examination of the results of 12 intercomparison test exposures so far published in the United States, the United Kingdom and Germany demonstrates that the film dosimeter, most frequently used in routine monitoring today, has an unfavourable measuring accuracy. Generally, it was found to be within ±30 to 50% in routine evaluation besides the fact that the measuring accuracy may depend on the type of dosimeter, the exposure and evaluation conditions as well as on the qualification of the measuring laboratory. Above all, new TLD and RPL dosimeters have a measuring accuracy of almost ±15% because of their energy and direction independence and their stability against environmental influences. (auth)

24469 (MORP-68-4) MEDICAL SURPAK SUMMARY REPORT. (National Center for Radiological Health, Rockville, Md.). Sept. 1968. 24p.

The Medical Surpak, a mailable radiation protection survey device designed and field tested by personnel of the National Center for Radiological Health, is described. It is used to provide estimates of x-ray beam size and symmetry, total filtration, Roentgen output, and half-value layer. The design, cost data, interpretation of results, field trials, and future use are discussed. (auth)

24470 (UCRL-50007-68-2, pp 1-8) HOT NITROGEN GAS FOR HEATING THERMOLUMINESCENT DOSIMETERS. Petrock, K. F.; Jones, D. E. (California Univ., Livermore. Lawrence Radiation Lab.).

A thermoluminescent dosimeter reader using hot N_2 gas for heating the TLD phosphors is described. (B.G.D.)

24471 (ZJE-28) USE OF CALORIMETRIC SOUNDS IN IN-PILE TECHNIQUE. Kott, Josef (Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Plant Div.). July 1968. 15p. Dep.

The development of calorimeters in Czechoslovakia for in-core dosimetry of neutrons and gamma radiation is discussed. (W.H.K.)

24472 DOSIMETRY WITH EXOELECTRONS. Kramer, J. PTB Mitt., 79: 9-14(Feb. 1969). (In German).

Cold light and cold electrons, luminescence, and exoelectron emission are two aspects of the same kind of procedures in solids. Like luminescence one can use exoelectron emission for dosimetry of ionizing radiation. Forms and features of exo-dosimeters, their sensitivity, their measuring range and apparatus for evaluation are described. Up to now, doses between 10^{-6} and 10^{-7} R can be measured; an extension to smaller and higher doses seems to be possible. (auth)

24473 MEASUREMENTS OF THE DOSE DISTRIBUTIONS OF HIGH ENERGY ELECTRON BEAMS WITH LiF THERMOLUMINESCENT DOSIMETER. Shiragai, Akihiro; Noda, Hiroji (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 1360-4(Jan. 1969). (In Japanese).

In order to discuss whether the dose distributions of high energy electron beams can be measured with LiF thermoluminescent dosimeter (TLD) or not, the energy, the dose and the dose-rate dependences of TLD were measured. These measurements were done in Lucite. The response per rad was independent of electron energy and was equal to that for ^{60}Co gamma rays. The response per rad increased about 18% with the increase of dose from 10 to 100 rads. The dose-rate dependence was not observed. The beam profiles and the central axis percentage depth doses of the electron beams from Toshiba 31 MeV betatron were measured at 10 to 29 MeV in Lucite phantom. (NSA of Japan)

24474 DOSIMETER FOR MEASURING THE DOSE OF X-RAYS, GAMMA-RAYS, AND NEUTRON BEAMS. (to Telefunken Patentverwertungsgesellschaft mbH). British Patent 1,147,757. Apr. 10, 1969. Priority date Apr. 15, 1965, Germany.

A dosimeter for gamma rays, x rays, and neutrons which consists of two concentrically arranged cylinders of material having different electron yield and a fiber-type or similar-type electrometer that measures the voltage between the two cylinders is described. (B.G.D.)

24475 DESIGN OF SKODA REACTOR CALORIMETERS. Kott, Josef; Teren, Samuel. Skoda Rev., No. 6, 47-51(1968).

Design parameters for various types of reactor calorimeters are presented. The calorimeters described include: single-body radial calorimeters; differential and conductivity calorimeters; membrane calorimeters; and radial tubular calorimeters. (D.C.C.)

Radiometric Instruments

Refer also to abstract 24382.

24476 (UCRL-Trans-10333) DESIGN OF GAMMA-GAMMA METHOD PROBES FOR MEASUREMENTS WITH A VARYING DISTANCE TO THE SURFACE OF THE INVESTIGATED MEDIUM. Kudryavtsev, Yu. I. Translated by A. M. A. Mincer for Univ. of California Lawrence Radiation Lab., Livermore, from Vestn. Leningrad. Univ., Ser. Geol. Geogr., 22: No. 18, 76-83(1967). 17p. Dep. CFSTI.

The geometrical characteristics of GGM probes working at various distances from the surface of the medium have been investigated theoretically. Formulas are given to determine the optimum parameters of probes in which the intensity of the characteristic and singly-scattered radiation is practically independent of the distance (air gap) between the probe casing and the surface under investigation. (auth)

24477 PRODUCTION OF CHEMISTRY-DEPENDENT GAMMA RAY AND THERMAL NEUTRON LOGS CORRECTED FOR POROSITY. Givens, Wyatt W. (to Mobil Oil Corp.). U. S. Patent 3,435,217. Mar. 25, 1969. Filed June 28, 1965.

The specification discloses a method and system for producing chemistry-dependent logs corrected for porosity from measured borehole count rates of thermal neutrons, gamma rays, and epithermal neutrons obtained with a thermal neutron detector, a gamma ray detector, and an epithermal neutron detector, all employed in combination with a fast neutron source. In carrying out the process, the observed epithermal neutron count rate is modified to obtain porosity-dependent measurements representative of that component of the measured thermal neutron and gamma ray count rates observed and due primarily to the effect of porosity. The measured thermal neutron and gamma ray count rates are

combined with the porosity-dependent measurements to obtain chemistry-dependent thermal neutron and gamma ray measurements corrected for porosity. (Official Gazette)

24478 BAROMETRIC COMPENSATION FOR GAUGING APPARATUS. Swift, Willard Everett (to The Foxboro Co.). U. S. Patent 3,435,221. Mar. 25, 1969. Filed Feb. 10, 1966.

An apparatus for barometric compensation of beta gauges employs means for sensing the barometric pressure in the general region of the beta gauge coupled to means for providing a compensatory electrical signal; the compensatory electrical signal, which is related to the barometric pressure, is employed to qualify the electrical signal output of the beta gauge receiver in a manner to cancel error appearing therein as a consequence of barometric pressure change. (Official Gazette)

24479 NEUTRON TRANSMISSION METHOD OF ANALYSIS AND APPARATUS THEREFOR. Mott, William E.; Rhodes, Donald F. (to Gulf Research and Development Co.). U. S. Patent 3,437,809. April 8, 1969. Filed July 6, 1965.

A neutron transmission method of quantitative analysis is described. High accuracy and precision are achieved by use of a high neutron count, a signal to noise ratio of at least 3.0, accurate determination of the noise of the system, expression of the concentration as a function of transmitted neutrons, and by relating that function to the neutron scattering cross section of the elements present in the sample so as to reduce the effect of the noise upon the results. An apparatus for measuring the number of neutrons transmitted through a sample is described which provides a beam of substantially parallel thermal neutrons to the sample and a beam of substantially parallel neutrons transmitted through the sample to a detector. The apparatus is shielded to exclude the effect of neutrons other than transmitted neutrons. (Offic. Gaz.)

Miscellaneous Instruments and Components

Refer also to abstracts 24399, 24426, 25078, 25153, 26036, 26047, 26098, 26130, 26134, 26142, and 26144.

24480 (AD-675154) ROCKET AND SATELLITE INSTRUMENTATION FOR IONOSPHERIC MEASUREMENTS. Final Report, January 1, 1965-December 31, 1967. Baker, Kay D.; Allred, Glenn D.; Burt, David A. (Utah Univ., Salt Lake City. Upper Air Research Lab.). May 1968. Contract AF19(628)-4995. 73p. CFSTI.

The report summarizes work performed under contract No. AF19(628)-4995 involving development and utilization of rocket and satellite probes for ionospheric measurements. In this research, particular emphasis has been given to development of rf probe techniques for electron density measurements and simultaneous utilization of these and many other instruments in coordinated measurements of special ionospheric conditions such as aurora, auroral absorption, etc. Other supporting instruments utilized include Langmuir probes, particle and x-ray counters and spectrometers, Lyman-alpha detectors, scintillators, Gerdien condensers, and photometers. Brief discussions of the rocket and satellite systems and the findings from the various launchings are presented with heavy reference to previous reports, papers, and publications. (USGRDR)

24481 (BARC-361) APPARATUS FOR THE DETERMINATION OF DISSOLVED GASES IN NUCLEAR REACTOR COOLANTS (WATER). Vartak, D. G.; Jose, C. J.; Prabhu, L. H. (Bhabha Atomic Research Centre, Bombay (India)). 1968. 17p. Dep.

A system has been set up at the Chemical Control Laboratory of the Reactor Operations Division to analyze the dissolved gases in reactor coolants. It consists of two parts, namely, one for stripping out the dissolved gases and measuring the total volume and the other called the analyzer for the determination of their percentage (v/v) composition. The analyzer can be used independently for the analysis of a sample of a mixture of carbon dioxide, oxygen, nitrogen, and hydrogen. (auth)

24482 (IFVE-SEF-68-45-K) AN INDICATION UNIT WITH A STORAGE OSCILLOGRAPH FOR THE TsVM (MINSK-2 DIGITAL COMPUTER)). Meshchanin, A. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1968. 13p. (In Russian). Dep.

An indication unit with a storage oscillograph Type C1-37 for fast transfer of the information from the digital computer is described. The device was designed for visual observation of online physics experiments. (auth)

24483 (ISS-68/34) ELECTRONIC CIRCUIT FOR TEMPERATURE CONTROL. Felici, C. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). Oct. 5, 1968. 10p. (In Italian). Dep.

An electronic circuit is described which controls the temperature by a continual and automatic regulation of the current in the heating element. (auth)

24484 (KURRI-TR-15) DATA PROCESSING OF NUCLEAR EXPERIMENTS. Miyake, Hirozo (comp.) (Kyoto Univ. (Japan). Research Reactor Inst.). [1965]. 52p. (In Japanese). Dep.

The rapid and accurate handling of the data amassed in nuclear experiments requires computer data processing. In view of the increasing importance of this technique a symposium was held at Kyoto University on February 1, 1965, to review the status of the subject in Japan. Abstracts of papers presented at this meeting include: data processing in high-energy physics experiments; general problems associated with multiparameter analysis equipment; data processing at BNL and NBS; data processing of γ spectra; status of data processing at the Eastern Universities and laboratories of the United States; time-shared use of small digital computers; the PDP-5 and its on-line use; the PDP-5 and automatic film analysis; and circuit elements used in data processing. (TTT)

24485 (NVO-1163-34) GEOPHYSICS ANALYSIS SYSTEM FOR SEISMOGRAM ANALYSIS. I.B.M. 7090 PROGRAMS. Luhrs, L. B.; Wabnik, F. (Beers (Roland F.), Inc., Alexandria, Va.). Nov. 19, 1964. Contract AT(29-2)-1163. 100p. Dep. CFSTI.

U.S.C.G.S. strong motion accelerometers and Carder displacement meters are used to record seismic signals from underground nuclear explosions. The output from these meters is edited, digitized, and processed by a FORTRAN II program on an IBM 7090-1401 system. Recorded signals are corrected for the response of the instrument. Velocities, resultant vectors, fourier spectra, and maximum amplitudes are computed. Radial and vertical components of velocity are multiplied together to aid in wave mode identification. Output is printed, punched on cards, and graphically displayed on a Benson-Lehner Electroplotter J. (auth)

24486 (SCL-T-67-252) TRANSISTOR RAPID PULSE AMPLIFIERS. Samueli, J. J.; Espi, G.; Sarazin, A. Translated from Onde Elec., 43: 1256-9(1963). 9p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 18: 33861. (W.H.K.)

24487 (SLAC-97) HIGH-SPEED SWITCHING PROPERTIES OF THE EMITTER-COUPLED TRANSISTOR-PAIR. Barna, Arpad (Stanford Linear Accelerator Center, Calif.). Mar. 1969. Contract AT(04-3)-515. 44p. Dep. CFSTI.

High-speed switching properties of the emitter-coupled transistor-pair are analyzed by means of a digital computer. Waveforms and risetimes are computed for a wide range of parameters. The resulting risetimes are interpreted in terms of the gain-bandwidth products of the transistors, external capacitances, and the risetime of the input signal. (auth)

24488 (UCID-3323) CHARACTERISTICS OF STANDARD FLOGIC CARDS. Kirsten, F. A. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 20, 1969. 29p. Dep. CFSTI.

A system of nanosecond logic cards and hardware, called FLOGIC, has been recently developed for high-energy physics instrumentation. The FLOGIC cards which are considered to be standard are described. (B.G.D.)

24489 (UCRL-50007-68-2, pp 31-4) FIELD INSTRUMENT FOR PLUTONIUM FECAL SAMPLE ANALYSIS. Bennett, W. P.; Tinney, J. F.; Cate, J. L. (California Univ., Livermore. Lawrence Radiation Lab.).

Sample collection techniques, sample preparation, a prototype fecal sample monitor, and calibration results using known concentrations of plutonium and americium in water are described. (B.G.D.)

24490 NUCLEAR ELECTRONICS: VERSATILE TIMER FOR THE INVESTIGATION OF SHORT-LIVED RADIONUCLIDES. Tharun, U. (Univ., Mainz). Kerntechnik, 11: 36-9(Jan. 1969). (In German and English).

A versatile electronic timer is described by means of which four measurement times and one pause time can be pre-set independently of one another, under three different operating programs, within the range from 0.1 to 9999.9 seconds (or minutes). The method of operation and the block diagrams of the timer and of the real time printer are discussed in detail. The print-out of measurement results takes place during the next measurement time without interfering with the counting. (auth)

24491 METHOD AND APPARATUS FOR MEASURING HIGH VACUUMS. Helmer, John C. (to Varian Associates). U. S. Patent 3,435,334. Mar. 25, 1969. Filed Apr. 4, 1966.

A reduction in the x-ray limit with a concomitant increase in ionization pressure gauge sensitivity to at least 10^{-14} torr is achieved by locating the ion collector out of line-of-sight of the source of x-rays, the ion beam source. The use of an ion source deriving ions of substantially equal energy followed by electrostatic deflection of the ions to the collector by means of a pair of mesh arcuate electrodes results in substantially equal paths for all deflected ions regardless of their respective charge-to-mass ratio and a reduction of x-ray reflection, respectively. (Official Gazette)

24492 ANALYSIS OF THE ERROR IN A SUBSTRACTION CIRCUIT FOR TWO SERIES OF PULSES DISTRIBUTED STATISTICALLY IN TIME. Vankov, Iv. Compt. Rend. Acad. Bulg. Sci., 21: 1279-82(1968). (In French).

The error in measurement with a subtraction circuit, a circuit which compares two signals and supplies an indication time difference was determined theoretically. The theoretical results were compared with experimental results reported in the literature and with experimental results obtained by using average frequency ratios of two pulse series and with different preliminary division coefficients. The agreement between the theoretical and experimental results is very good. (J.S.R.)

24493 AN ULTRASONIC SYSTEM TO PLOT THE THICKNESS PROFILE OF A FUEL ELEMENT COOLANT CHANNEL. Arave, A. E. (Phillips Petroleum Co., Idaho Falls, Idaho). Nucl. Appl., 6: 332-5(Apr. 1969).

An ultrasonic system to plot the thickness profile of a fuel element coolant channel was developed to measure the ETR and ATR fuel elements in a canal after being removed from the reactor. It has an accuracy of 0.5 mils, a resolution of 0.1 mil, and a range from 50 mils to 175 mils. The heart of the system is a probe holding two 8-MHz, 10-mil thick lead zirconate titanate piezoelectric crystals. Distance between channel walls is obtained by measuring the time for an 8-MHz sound burst to travel between the crystals which are held next to the walls. The signal received by one crystal, transmitted from the other crystal, is used as a trigger for a time-to-analog converter that is connected to the Y axis of a recorder. Longitudinal distance in the channel is converted to an analog output to drive the X axis of the same recorder. (auth)

24494 DYNAMIC CHARACTERISTICS OF A PLUGGING INDICATOR FOR SODIUM. McPheeters, Charles C.; Biery, John C. (Los Alamos Scientifc Lab., N. Mex.). Nucl. Appl., 6: 573-81(June 1969).

The characteristics of a sodium system plugging indicator have been studied with the instrument operated in both the bare orifice and partially plugged modes. The plugging temperature produced when the orifice is initially bare indicates the point where nucleation of the impurity is first noted and is strongly influenced by flow rate and cooling rate. Thus, in the bare orifice mode the meter must be calibrated to produce oxygen concentration as a function of plugging temperature. In the partially plugged mode, saturation temperature is indicated each time a flow rate arrest occurs, and therefore, no calibration is required. Also, with Na_2O on the orifice, the rate of flow increase or decrease through the orifice permits the calculation of mass transfer coefficients for the dissolution or precipitation of Na_2O. (auth)

24495 NEUTRON-GENERATING DEVICE. Hashimoto, Kenjiro (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1968-31280. Dec. 18, 1968. Filed Feb. 12, 1965.

By the method proposed, the neutron generator can be disassembled or assembled easily. The neutron-generating device is divided in two parts: the part, including a target, evacuator and accelerating tube; and the rest, including a deuterium generator, etc. The base plate, supporting the latter part, slides into the base plate, supporting the former part, or vice versa. (NSA of Japan)

24496 DEVICE FOR GENERATING NEUTRONS. Takahama, Takeshi (to Hitachi Ltd.). Japanese Patent 1969-78. Jan. 6, 1969. Filed Feb. 19, 1965.

In the neutron generating device proposed, the support for an electrode to control the secondary electrons is strengthened mechanically. In the neutron-generating device, including an accelerating tube to accelerate deuterium ions and a target of tritium, the electrode for controlling the secondary electrons is installed in the accelerating tube with its insulating support of an alumina porcelain. (NSA of Japan)

Radiation Effects on Instruments and Instrument Components

Refer also to abstract 25446.

24497 ELECTRIC CONDUCTION IN FLOAT-ZONE SILICON AFTER PROLONGED GAMMA IRRADIATION. Kao, K. C. (Univ. of Manitoba, Winnipeg); Pal, N. Electron. Lett., 4: 571-2(Dec. 13, 1968).

The electrical conductivities of float-zone silicon doped with arsenic for n type and with boron for p type were measured before and after gamma irradiation using a four-point probe. Some new phenomena after prolonged irradiation are reported, and a brief discussion is given. (auth)

24498 CONDITIONS CONTRIBUTING TO RADIATION-INDUCED THERMOCOUPLE DECALIBRATION. Leonard, James H. (Univ. of Cincinnati). Nucl. Appl., 6: 202-8(Mar. 1969).

Chromel/Alumel thermocouples were calibrated at the temperatures of boiling water and melting tin and lead before, during, and after exposure to several cycles of nuclear radiation. A temporary calibration shift of up to 50 μv was observed at all three calibrating temperatures persisting for at least one hour following cessation of exposure. Comparison with corresponding data from a previous experiment indicates that the relative location of flux and temperature gradients along the thermocouple leads has a major influence on the magnitude of decalibration encountered. The effect is attributed to radiation-produced scattering centers subject to self-annealing processes. For in-pile thermocouple installations, temperature gradients should be restricted to locations outside high flux regions to minimize potential radiation-dependent, decalibrating effects. (auth)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 24123, 24173, 24175, 24358, 24400, 24591, 24624, 24631, 24632, 24634, 24642–24644, 24694, 24708, 24722, 24725, 24727, and 24735.

24499 (A-AC-82/G/L-1243, pp 26-30) BUILDUP FACTORS OF ^{90}Sr FOR LIVING AND DEAD MARINE PLANTS. Baranova-Ryndina, D. D.; Poilkarpov, G. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). (In Russian).

An understanding of the migration of ^{90}Sr in the sea requires knowledge of the buildup factors for living, dead and decomposing marine organisms. Experiments were carried out with hydrobionts aquaria, the water of which contained added $^{90}SrCl_2$ at a concentration of 8 μCi/l, determining the concentration in the water, the hydrobionts, and the detritus. It was found that the dead brown algae possess a relatively large buildup factor, close to that of the living plants. The corresponding value for the detritus was low. This behavior is attributed to the alginic acid content of the plant; this acid is decomposed only slowly and with advancing hydrolysis the ^{90}Sr buildup factor is reduced. After decomposition of the plants, the ^{90}Sr is released into the medium. The living and dead green and red algae and their detritus possess a relatively low buildup factor. (TTT)

24500 (BMwF-FBK-69-1) RADIOBIOLOGICAL AND TRACER EXPERIMENTS AS A CONTRIBUTION TO THE INVESTIGATIONS OF THE MOLECULAR STRUCTURE OF EUCARYONT-CHROMOSOMES. Scheuermann, W. (Technische Hochschule, Hanover (West Germany). Institut fuer Strahlenbiologie). Jan. 1969. 95p. (In German). Dep.

The effects (induction of chromosome aberrations) of radionuclides (^{3}H, ^{14}C, and ^{35}S), that were incorporated systematically into defined chromosome structures of Vicia faba were studied. The investigations showed that the primary effect of the radioactive decay of nuclides in the DNA-molecule was considerably smaller with eucaryonts than with procaryonts. The theoretical value of 1 (^{14}C and ^{32}P) for the probability of effect was not observed even with procaryonts. These possible causes are discussed: breaking mechanism of the DNA-double-helix, repair processes, and structural differences. The low probability of effects with ^{35}S suggested that the acid proteins were not directly involved in the breaking occurrences. (auth)

24501 (CEA-R-3703) METABOLISM AND INTERNAL DECONTAMINATION OF ZIRCONIUM-NIOBIUM SALT. Gavend, Michel; Rinaldi, Jean-Pierre; Rinaldi, Renaud (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Jan. 1969. 16p. (In French). Dep.

The metabolism of a salt of ^{95}Zr-^{95}Nb injected by the intravenous route in rats was studied with the following results. There was a fast decrease of the blood concentration of radioisotopes, a durable accumulation of radioisotopes in the bone, and a strong urinary elimination during the first hours. The possibilities of internal decontamination of ^{95}Zr-^{95}Nb were also studied. Among the tested chemicals, only zirconium citrate seemed effective. (auth)

24502 (CONF-670649-11) EFFECT OF TIME AND ACTION OF CADMIUM ON THE TOTAL ACCUMULATION OF ^{65}Zn ADMINISTERED ORALLY TO THE GUINEA PIG. Chueca, A.; Iranzo, E.; Garcia del Amo, C.; Santos-Ruiz, A. (Madrid Univ. (Spain). Departamento de Bioquimica). [1967]. 18p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The variations of the distribution of ^{65}Zn in the guinea pig was investigated at 5, 15, 30, 45, 60, 90, and 120 days after direct tube administration to the stomach were determined. The effect of cadmium on the Zn distribution was also determined. In the organs of rapid assimilation and elimination (liver, pancreas, spleen, etc.) there was noticed a decrease of the ^{65}Zn at the end of five days, but between 15 and 30 days there was a marked stimulation in the retention of ^{65}Zn, followed by inhibition of the isotopic retention. The intestine belongs to the group of organs having a marked stimulation of ^{65}Zn retention. In the organs of slow assimilation and elimination (brain and muscles) as well as in the skin, hair, and teeth Cd^{2+} appears to stimulate the retention of ^{65}Zn. In the whole organism the amount of ^{65}Zn is more altered by the conjunction of Zn and Cd than by ^{65}Zn alone, but only between the 45th and 60th day does it appear that Cd^{2+} exercises an inhibition on the retention of ^{65}Zn. (tr-auth)

24503 (CONF-670649-25) ISOTOPES IN MEDICAL AND BIOLOGICAL INVESTIGATION. Linazasoro, J. M. (Instituto de Investigaciones Medicas, Madrid (Spain)). [1966]. 30p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

A bibliographic review is given of the use of radioisotopes in medicine and biology. The areas in which radioisotopes are applied include their use as tracers, studies on the metabolic pool and dynamic equilibrium, absorption studies, determination of the steps in in vivo and in vitro synthesis, and measurement of the isotopic equilibrium. (J.S.R.)

24504 (CONF-670649-32) RELATION OF THE ^{65}Zn CONTENT IN THE BLOOD AND MILK IN THE GOAT. Arias Olande, A.; Garcia del Amo, C. (Madrid Univ. (Spain). Departamento de Bioquimica). [1967]. 13p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The distribution of ^{65}Zn in the blood and milk of goats was followed for 30 days after injection of the radioisotope. The results obtained showed that the ^{65}Zn in the blood plasma is directly proportional to that in the milk. In the blood, the plasma is the component containing the most of the radioisotope. The content of ^{65}Zn in the red corpuscles undergoes very small variations, and only on the 26th day is it greater than the content in the plasma. The ^{65}Zn is eliminated by the milk and at the end of 30 days 14.5% of the injected dose was eliminated. The maximum content of ^{65}Zn, both in the milk and blood, is found 24 and 48 hrs after injection. The milk, even without milking, does not concentrate the isotope. The ^{65}Zn in the skimmed milk is always proportional to or less than that of whole milk. The relation of the ^{65}Zn content in the various components of the milk remains constant during the lactation. (tr-auth)

24505 (NYO-2598-45) THE LOSS OF ORGANIC AND INORGANIC MATERIALS FROM ABOVE-GROUND PLANT PARTS, WITH A SPECIAL REFERENCE TO DECONTAMINATION OF PARTS UTILIZED FOR FOOD. Progress Report, 1968–69. Tukey, H. B. Jr. (Cornell Univ., Ithaca, N. Y. Dept. of Floriculture and Ornamental Horticulture). Feb. 22, 1969. Contract AT(30-1)-2598. 29p. Dep. CFSTI.

Radioisotopes were used to demonstrate leaching of organic and inorganic substances from stems, foliage, flowers, and fruit by the action of aqueous solutions including rain, dew, and mist. It was shown that metabolites were leached from over 175 different species, including coniferous and deciduous forest and shade trees, tree fruits, small fruits, grapes, tropical and subtropical plants, vegetable crops, grains, grasses, forage crops, woody and herbaceous ornamentals, plantation crops, tropicals, and conservatory plants. Factors influencing leaching were age, leaf characteristics, type and nature of plant parts, metabolites being leached, plant nutrient status within the plant and in the root medium, nature of the leaching solution, light and darkness, temperature, duration of leaching period, and injury to plant tissues. Cations such as calcium were leached by exchange of hydrogen in the leaching solutions for cations on the cell wall and cuticle exchange sites, diffusion of cations within the leaves to the surface, and a combination of both exchange and diffusion. Substances leached from one plant can be absorbed by the roots and foliage of the same and other nearby plants and reutilized in growth; such cycling of substances was determined by the use of radioisotopes. Experiments were conducted to show that gibberellins were leached from the foliage of Chrysanthemum morifolium and Pharbitis nil; results suggested that the substances necessary for flowering in these plants were removed or changed by leaching. Effects of leaching on production of anthrocyanins in Euonymus alatus were studied. Cycling of leached metabolites in the tropical rainforest was studied by spraying ^{137}Cs, ^{54}Mn, and ^{85}Sr on to the forest floor of plots in the rainforest of Puerto Rico. Only after six months following treatment were measurable amounts of radioactivity detected in the plants. Studies on epiphytes in the rainforest were conducted using ^{32}P; it was shown that they were able to absorb nutrients through the foliage much more effectively than through the rootlets. The use of ^{32}P for studies on leaching and nutrition of cuttings propagated under intermittent mist showed that more than 95% of the phosphorus absorbed by cuttings from the nutrient mist was absorbed by the above-ground leaves and stem. It was shown that the growing roots of dormant plants absorb ^{32}P in direct proportion to the root temperature above freezing. Decontamination studies were carried out on beans, corn, lettuce, peas, parsley, and tomatoes. Root absorption and translocation of ^{90}Sr into the fruit of bean, pea, and tomato was noted only if contamination oc-

curred after the onset of flowering. Experiments on potatoes showed that ^{90}Sr falls on leaf surfaces from where it can be leached to the soil, absorbed by the roots, and translocated into the storage organs and above-ground plant parts. (H.L.W.)

24506 (SPR-9) THE INFLUENCE OF IRRADIATED AND NON-IRRADIATED GLUCOSE SOLUTIONS ON HUMAN FIBROBLASTS. Kellner, G.; Kaindl, K. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Institut fuer Biologie und Landwirtschaft). Apr. 1967. 17p. Dep.

Human fibroblasts of various strains were cultivated from explants of skin and connective tissue. A hemocytometer was used for counting cells, and the average cell count of five tubes at the beginning of the experiment served as a control. Glucose solutions were γ-irradiated using a ^{60}Co source. The original nutrient solution was removed from the tubes and replaced with isotonic salt solution with or without added glucose. Cell counts were made after 24 or 48 hrs. Tables are presented to show effects of irradiated glucose concentrations in salt and in nutrient solutions on human fibroblasts. A cytotoxic effect of unirradiated glucose was found at concentrations of 5 mg/ml, and at lower concentrations a dose-dependent cytotoxic effect of irradiated glucose was demonstrated. (H.L.W.)

24507 (UCRL-50564) CONCENTRATION FACTORS OF CHEMICAL ELEMENTS IN EDIBLE AQUATIC ORGANISMS. Chapman, William H.; Fisher, H. Leonard; Pratt, Michael W. (California Univ., Livermore. Lawrence Radiation Lab.). Dec. 30, 1968. 50p. Dep. CFSTI.

Tables of concentration factors for edible plants, fish (for both salt and fresh water), and invertebrates, based on an extensive review of the stable element data available in the literature are presented. The raw data from which the concentration factors were derived are included in an appendix, as well as the methods employed in estimating the concentration of elements in those situations where there was an absence or paucity of information available. (auth)

24508 PECULIARITIES OF THE BEHAVIOR OF ^{140}Ba AND ^{147}Pm IN THE ORGANISM AFTER INTRATRACHEAL INTRODUCTION. Dobryakova, G. V. (Inst. of Biophysics, Moscow). Radiobiologiya, 9: No. 1, 101-2(1969). (In Russian).

The behavior of ^{140}Ba and ^{147}Pm after intratracheal introduction was studied in experiments on white rats, and the rate and magnitude of the removal of radioisotopes from the lungs were also determined. It was shown that in 14 days up to 88% of the ^{140}Ba introduced and up to 35% of the ^{147}Pm introduced are resorbed from the lungs; in this case the maximum rate of assimilation of the isotopes was observed in the first 2 min after administration. The elimination of ^{140}Ba from the lungs with the aid of the ciliated epithelium comprised 7.1% in 14 days, that of ^{147}Pm about 40%. The removal of the radioisotopes of barium and promethium from the lungs after a single introduction is satisfactorily described by an exponential function. (JPRS)

24509 TRANSFER OF ^{90}Sr THROUGH THE PLACENTARY BARRIER IN COWS. Sirotkin, A. N.; Burov, N. I.; Korneev, N. A. Radiobiologiya, 9: No. 1, 103-7(1969). (In Russian).

Continuous oral administration of strontium-90 to cows during the entire period of pregnancy is accompanied by a passage of the isotope through the placenta into the fetus. The transfer in this case comes to 0.38 to 1.73% of the amount of the radioisotope that penetrated into the mother's stomach, while the accumulation factor is 1.0 to 4.8. The observed ratio of strontium-90 to calcium in the case of their transfer from the mother's diet to the skeleton of the fetus varies within the range 0.07 to 0.16. Changing the calcium content in the diet of the mother cow from 15 to 18 g to 42 to 51 g lowers the strontium-90 retention in the skeleton of the fetus by 2 to 4-fold. There is a nonuniform distribution of strontium-90 in the skeletons of newborn calves. The coefficient of nonuniformity is 2.1 to 3.6. (JPRS)

24510 ROLE OF TISSUE PROTEINS IN THE FIXATION OF CERTAIN RADIOACTIVE ISOTOPES. Puchkova, S. M. (Inst. of Biophysics, Moscow). Radiobiologiya, 9: No. 1, 108-10(1969). (In Russian).

The physicochemical state of ^{22}Na, ^{137}Cs, ^{45}Ca, ^{90}Sr, ^{144}Ce, and ^{91}Y in the livers, kidneys, and muscles of rats was investigated. It was shown that ^{144}Ce and ^{91}Y are almost entirely (95 to 100%) bound to the proteins of the indicated organs, while ^{45}Ca and ^{90}Sr are partially (from 15 to 53%) protein-bound. It was noted that the muscle proteins bind ^{45}Ca and ^{90}Sr to a greater degree than the proteins of the liver and kidneys. Moreover, the content of protein ^{45}Ca in all the organs studied is an average of twice as high as that of protein ^{90}Sr. The distribution of the isotopes among individual fractions of the tissue proteins was characterized. (JPRS)

24511 INFLUENCE OF SUBLETHAL DOSES OF PENETRATING RADIATION ON THE DISTRIBUTION OF VARIOUS COMPOUNDS OF RADIOACTIVE IRON IN THE ORGANS AND TISSUES OF THE GUINEA PIG. Tagi-Zade, S. B.; Beibutova, T. S. (Inst. of Roentgenology, Radiology, and Oncology, Baku). Radiobiologiya, 9: No. 1, 81-6(1969). (In Russian).

The distribution of radioactive iron ascorbate and ferric chloride in the organs and tissues of guinea pigs 1 and 7 days after peroral and subcutaneous administration of the preparations on the third day after irradiation with sublethal doses of penetrating radiation was studied. In all the periods of the investigation in the case of peroral administration of the preparations, the incorporation of the label of both iron compounds was lower among the irradiated animals than in the control group. With respect to ferric chloride, this situation was also unchanged in the case of parenteral administration of the preparation. In the case of subcutaneous injection, several times as much iron ascorbate is deposited as ferric chloride, in comparison with irradiated and control animals. (JPRS)

24512 EFFECTS OF CYSTEINE AND 4-AMINO-1-NAPHTHOL ON SOLUTIONS OF LYSOSOMAL ENZYMES EXPOSED TO HIGH DOSES OF RADIATION. Hamdy, M. K.; Noaman, M.; Caster, W. O. (Univ. of Georgia, Athens). Radiat. Res., 38: 214-22 (Apr. 1969).

The effect of γ-irradiation on the lysosomal enzymes (acid phosphatase, DNAase, RNAase, β-galactosidase, β-glucuronidase, muramidase, and arylsulfatase) in the absence and in the presence of cysteine or 4-amino-1-naphthol (4A1N) was studied. Inactivation of these enzymes in the absence of the radioprotectors, cysteine, and 4A1N, followed first-order kinetics. Muramidase was the most radiosensitive of all enzymes, having a D_{37} value of 4 krads, whereas acid phosphatase was the most resistant, having a D_{37} of 290 krads. Cysteine (0.1 mM) exerted no radioprotective effect on β-glucuronidase, the D_{37} decreasing by 4 krads, whereas β-galactosidase was slightly protected, the D_{37} increasing by 3 krads. The following enzymes were markedly protected: arylsulfatase, D_{37} increased by 8 krads; muramidase, increased by 9 krads; DNAase, increased by 13 krads; acid phosphatase, increased by 360 krads. Cysteine exerted some radioprotection on RNAase only, with doses ranging from 5 to 10 krads. 4-Amino-1-naphthol (0.1 mM) exerted no protective effect on arylsulfatase; the D_{37} decreased by 12 krads. The remaining enzymes were protected: the D_{37} of acid phosphatase increased by 400 krads; β-glucuronidase, 193 krads, β-galactosidase, 148 krads; DNAase, 40 krads; muramidase, 22 krads; RNAase, 4 krads. (auth)

24513 INVESTIGATION OF THE INFLUENCE OF IONIZING RADIATION ON DNA AND DNP BY A LUMINESCENCE METHOD. Pisarevskii, A. N.; Spitkovskii, D. M.; Cherenkevich, S. N.; Andrianov, V. T.; Soshina, N. V. (Belorussian State Univ., Minsk). Radiobiologiya, 9: No. 1, 3-6(1969). (In Russian).

Changes in the structure of DNA and DNP, induced by ionizing radiation, are detected by the luminescence method. In the case of irradiation of DNP with $1-10 \times 10^3$ R, there is a sharp decrease in the intensity of the luminescence of DNP to values close to those for DNA. As a working hypothesis it is proposed that this is because of a transition of portions of the DNA molecules from the quasisingle-stranded state to the state possessed by DNA in solution. The DNA contained in DNP is more radioresistant than free DNA. (JPRS)

24514 SOME PHYSICOCHEMICAL CHANGES IN DNA ISOLATED FROM THE ORGANS OF IRRADIATED RATS. Ivannik, B. P.; Ryabchenko, N. I. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 9: No. 1, 7-14(1969). (In Russian).

Rats of the Wistar line were irradiated with the γ-rays of ^{60}Co at doses from 5 to 100 kR and a dose rate of 5 kR/min. It was shown that there is a statistically significant increase in the number of single cleavages in the DNA isolated from the rat liver and thymus gland immediately after irradiation. The number of single cleavages increases as a linear function of the radiation dose. The radiosensitivity of DNA preparations isolated from the liver and thymus gland immediately after irradiation of the rats is the same. Postradiation destruction of DNA in the thymus gland of rats irradiated at a dose of 1 kR is more intensive than in the liver. With increasing dose, a statistically significant increase in the bonding of protein to the DNA isolated from the livers of the irradiated rats is observed. The melting point of DNA is not lowered when the DNA is isolated from the rat organs immediately after irradiation. (JPRS)

24515 VULNERABILITY OF IRRADIATED SPERM DNP TO DNAase I. Moiseenko, E. V. (Inst. of Biological Physics, Pushchino on the Oka, USSR). Radiobiologiya, 9: No. 1, 15-20(1969). (In Russian).

The dependence of the vulnerability of preparations of DNA and DNP obtained from loach sperm to DNAase I on radiation damage to the supermolecular structure of DNA was investigated. The magnitude of the radiation effect was judged according to the yield of nucleotides after treatment of the preparations with DNAase I. It was shown that the vulnerability of irradiated solutions of supermolecular DNA to DNAase I increases slightly, reaching 138% of the control after irradiation at a dose of 40 kR. The increase in the vulnerability of the irradiated sperm heads to DNAase I was of the same order of magnitude as that of DNA solutions. No effect of activation was detected on strand-like and precipitated DNP. The activation effect in the case of irradiation of DNA is associated with a breakdown of the gel-like structure of the solution, and in the case of the heads with radiation damage to the coats. (JPRS)

24516 ON THE HIGH RADIOSENSITIVITY OF THE BIOSYNTHESIS OF MITOCHONDRIAL DNA. Galkin, A. P.; Todorov, I. N. (Scientific Research Inst. of Medical Radiology, Kharkov). Radiobiologiya, 9: No. 1, 21-5(1969). (In Russian).

A comparative study was made of the incorporation of ^{14}C-thymine (specific activity 26 mCi/g) into the nuclear and mitochondrial DNA of the livers and spleens of white rats in vivo, together with an investigation of the DNA concentration of these organelles, 12 and 24 h after whole-body x irradiation at a dose of 800 R. A substantially greater damage to biosynthesis of the mitochondrial DNA in comparison with the nuclear DNA was detected at these periods of investigation of acute radiation sickness; moreover, in the spleen mitochondria the radiation damages were more pronounced than in the liver mitochondria. (JPRS)

24517 EFFECTS OF ADENOSINETRIPHOSPHORIC ACID ON THE OXYGEN LEVEL IN THE TISSUES IN CONNECTION WITH ITS INFLUENCE ON THE RADIOSENSITIVITY OF ANIMALS. Rogozkin, V. D.; Marinenko, E. I.; Plyushchev, A. K. (Inst. of Biophysics, Moscow). Radiobiologiya, 9: No. 1, 26-30(1969). (In Russian).

In a study of the mechanism of the radioprotective action of ATP, the O_2 pressure in the organs of mice and rats and the change in the blood pressure were determined. To compare the radioresistance with the level of O_2 pressure, the animals were irradiated with the γ rays of ^{60}Co at doses of equal $LD_{35/30}$ various times after the administration of ATP. It was shown that ATP produces the greatest protective effect when injected intramuscularly into mice and rats in doses of 175 mg/kg and 350 mg/kg 15–20 min before irradiation. The administration of the indicated doses of ATP produces a drop in pO_2 by 80% of the original level in the spleen and kidney tissues of healthy animals after 15 min. (JPRS)

24518 ON THE SECONDARY ROLE OF THE HORMONES OF THE ADRENAL CORTEX IN THE MECHANISM OF THE INDUCTION OF POSTRADIATION SYNTHESIS OF GLYCOGEN IN THE LIVER. Kendysh, I. N.; Fedotov, V. P.; Moroz, B. B.; Dubrovin, A. D. (Inst. of Biophysics, Moscow). Radiobiologiya, 9: No. 1, 31-5(1969). (In Russian).

In this work the mechanism of the postradiation induction of glycogen synthesis in the livers of starving rats was studied. It was concluded that the radiation-induced synthesis of glycogen in the liver is due to glycogenogenesis at the expense of substrates arising from decomposing radiosensitive tissues, while the role of the hormones of the adrenal cortex in this process is secondary and is reduced chiefly to the involvement of the substrates in glycogenogenesis. (JPRS)

24519 FORMATION OF SPECIFIC AND NONSPECIFIC IMMUNOGLOBULINS IN THE LYMPHOID CELLS OF GUINEA PIGS SUBJECTED TO X IRRADIATION AFTER THE INJECTION OF AN ANTIGEN. Lebedev, K. A.; Ganina, V. Ya. (Inst. of Medicobiological Problems, Moscow). Radiobiologiya, 9: No. 1, 36-40(1969). (In Russian).

A decrease in the percentage of cells synthesizing specific antibodies was observed in the early periods after irradiation among cells producing globulins in the lymph nodes of guinea pigs immunized with diphtheria antitoxin and irradiated on the second day after the last injection of the antigen with massive doses of x rays (1200, 500 R), while the intensity of antibody synthesis in the cells decreased. During later periods the number of globulin-producing cells increased, and a large percentage of antibody-containing cells appeared among them. In the lymph nodes of immunized guinea pigs subjected to the action of low doses of radiation (80 R) and after the injection of an India ink suspension, an increase in the number of globulin-producing cells and an increase in the percentage of antibody-synthesizing cells among the latter were observed. (JPRS)

24520 REJOINING OF X-RAY-INDUCED BREAKS IN THE DNA OF EHRLICH ASCITES TUMOUR CELLS IN VIVO. Matsudaira, Hiromichi (National Cancer Centre Research Inst., Tokyo); Nakagawa, Chiyoko; Hishizawa, Tokutaro. Int. J. Radiat. Biol., 15: 95-100(July 1968).

Ascites tumor cells were inoculated into the peritoneal cavity of mice. Three days later the mice were given intraperitoneal injections of ^3H-thymidine and x-irradiated. At intervals after irradiation ascites cells were collected in saline and centrifuged. Autoradiography showed no difference in the percentage of labeled cells between experiments and unirradiated controls. The cell suspension was further diluted and aliquots were introduced on sodium dodecyl sulfate in sodium hydroxide that had been layered on a linear sucrose gradient. After centrifugation of the gradients the radioactivity of the samples was determined by a liquid scintillation spectrometer. The changes in the sedimentation profiles of the DNA from the ascites tumor cells obtained at intervals after irradiation of living mice showed a shift of the peaks of broken DNA toward the bottom of the gradient with increasing intervals after irradiation. This indicated that the rejoining of x-ray-induced breaks in the DNA occurred in the tumor cells in the body of living mice during a short interval after irradiation. (H.L.W.)

24521 LYMPHOCYTES AND TRANSPLANTATION IMMUNITY. Wilson, Darcy B.; Billingham, R. E. (Univ. of Pennsylvania, Philadelphia). Advan. Immunol., 7: 189-273(1967).

A review is presented of the role of lymphocytes in the origin and development of hypersensitivity to homografts. Evidence obtained from in vivo studies of the immune response is reviewed with regard to identification of immunologically competent cells, the process of sensitization, and the effector side of the immunological reflex. Some topics discussed are mixed lymphocyte reactions in the skins of irradiated hamsters, local graft-versus-host reactions in the kidney, transformation of the immunological status of lymphoid cells by ribonucleic acid, and the significance of the cellular infiltrate in a homograft. Evidence obtained from in vitro studies of the immune response is reviewed with regard to lymphocytes as effectors of immunity, macrophages and antigen, the blastogenic response of lymphocytes in culture, and cooperative interaction of lymphocytes and macrophages. A list of approximately 275 references is included. (H.L.W.)

24522 ELECTROPHORETIC STUDIES OF LACTATE DEHYDROGENASES IN TISSUES OF THE HAMSTERS, CRICETULUS GRISEUS, MILNE-EDW., AND CRICETULUS MIGRATORIUS, PALL. Hayford, Anne Heaney. Boston, Boston Univ., 1968. 116p. Thesis.

The lactate dehydrogenase isograms of more than 20 tissues from both male and female Armenian (Cricetulus migratorius) and Chinese (Cricetulus griseus) hamsters were obtained on cellulose acetate strips and on polyacrylamide disc gels. The pH activity curves of crude enzyme preparations were obtained. A broad maximum was obtained with pyruvate as the substrate (pH 6 to 8). A maximum close to pH 8 was obtained with α-ketovalerate as the substrate. In both species, sperm-associated LDH-X was found to migrate with the usual LDH bands LDH-1, -2, and -5. LDH-X was found to appear earlier (at 20 to 25 days) in the Armenian hamster than in the Chinese hamster (at 40 to 45 days). The appearance corresponds to the appearance of mature sperm in both species. Lactate dehydrogenase isoenzyme patterns of 10 adeno-12, 2 polyoma, and 8 parainfluenza-SV 40 tumors were obtained and compared with patterns obtained from 2 x-ray and 1 methylcholanthrene induced tumors. LDH-3, -4, and -5 were found in adeno-12 induced tumors, -1, -2, -3, -4, and -5 were found in parainfluenza-SV 40 induced tumors. LDH-5 only was found in the x-ray and methylcholanthrene induced tumors. Polyoma transformed cell lines showed a large amount of LDH-4 in addition to LDH-5. These studies have shown that the isoenzyme system of lactate dehydrogenase can be used to characterize cellular metabolism of tumors and tissue culture cell lines. Ammonium persulfate, in a level commonly used to catalyze the polymerization of polyacrylamide gels was found to have no effect on either the level of lactate dehydrogenase activity or on the distribution of lactate dehydrogenase activity on isograms. The lack of reduced enzyme activity in the presence of ammonium persulfate is curious since it has been reported that lactate dehydrogenase molecules have site-active sulfhydryl groups. (Diss. Abstr.)

24523 KINETICS OF HYDROLYSIS OF SOME GOOD SUBSTRATES OF ACETYLCHOLINESTERASE. HYDROGEN–DEUTERIUM EXCHANGE OF TRYPSIN. Lenz, David Erwin. Boston, Boston Univ., 1968. 317p. Thesis.

A study was undertaken to find a way of directly measuring the formation of the acetyl–enzyme intermediate ES′ in the Michaelis–Menten kinetic scheme for acetylcholinesterase: $E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_2} ES' \xrightarrow{k_3} E + P_2$. The enzyme-catalyzed hydrolysis of both 3-$+P_1$

acetoxypyridine-1-oxide and -1-methiodide were studied in the presence of trimethylammonium ion. Studies of pre-steady-state kinetics of hydrolysis were carried out using m-(trimethylammonium)phenyl acetate iodide as the substrate. p-(Trimethylammonium)phenyl acetate iodide was also subjected to enzymatic hydrolysis. The results of this study supported the acetylenzyme intermediate hypothesis and demonstrated the generality of the kinetic scheme proposed for acetylcholinesterase-catalyzed hydrolysis of acetyl esters. The rate and extent of hydrogen-deuterium exchange of trypsin was observed by ir spectroscopy by studying the rate of disappearance of the Amide II band with time. The technique of hydrogen exchange allows observation of all portions of the protein molecule and is well suited as a method of determining whether or not a protein undergoes conformational changes as pH, temperature, or ionic strength are varied. In addition, if substrates or inhibitors bind to an enzyme with subsequent conformational changes, this should be observable by H-D exchange. To examine this general area, trypsin, DIP-trypsin, and TLCK-trypsin were studied over a pD range of 2.4 to 9.2 by H-D exchange. Trypsin was found to exchange at 23°C and the exchange constants were not pD dependent over a 10^6-fold pD range for trypsin, DIP-trypsin, and TLCK-trypsin. The number of labile hydrogens that exchanged varied with pD, but this appears to be dependent on the molecular form of trypsin at any pD. The data agree well with previous physiochemical studies of trypsin where little conformational change was observed over the pH range 2.0 to 8.0. (Disser. Abstr.)

24524 SCANNING AS DOCUMENTATION IN SJOERGREN'S SYNDROME. Gelinsky, P.; zum Winkel, K.; Hasper, M. (Univ., Heidelberg). Fortschr. Geb. Roentgenstr. Nuklearmed., 110: 266-70(Feb. 1969). (In German).

Scintigraphy of the salivary glands using $^{99m}TcO_4$ and a scintillation camera (Anger) is described. Its clinical use for the optical demonstration of Sjögren's syndrome is emphasized. (auth)

24525 BONE SCANNING WITH ^{87m}Sr AND ^{85}Sr. Umek, H.; Sorantin, H.; Czembirek, H. (Clinic of Internal Medicine, Seibersdorf, Austria. Seibersdorf Reactor Center, Austria). Fortschr. Geb. Roentgenstr. Nuklearmed., 110: 209-14(Feb. 1969). (In German).

A selection of cases from a total material of 21 patients is described in order to demonstrate the authors' experience in the use of ^{87m}Sr and ^{85}Sr for bone scintigraphy as an additional diagnostic method. The superiority of the short-lived radioactive substance ^{87m}Sr is mentioned. (auth)

24526 IN VITRO STUDIES ON THE SYNTHESIS OF IMMUNOGLOBULINS BY HUMAN TISSUES OF THE FEMALE GENITAL SYSTEM. Aiuti, F.; Altieri, R.; Reverberi, L.; Catani, S. (Univ., Rome). Boll. Soc. Ital. Biol. Sper., 44: 1504-6(Sept. 30, 1968). (In Italian).

The results of the in vitro synthesis of immunoglobulins (Ig) in some organs of the female genital system are reported. The female organs studied were the vagina, endometrium, fallopian tube, and ovary. In all studies on the vagina there was a synthesis of IgG, and in two cases there was synthesis of IgA. IgM was not synthesized in the vagina or any of the other organs. In the endometrium the formation of Ig was much less constant than in the vagina. The fallopian tube and the ovary gave identical results to the vagina. (J.S.R.)

24527 EFFECT OF IRRADIATION ON SOME LYOPHILIZED PROTEINS. Friedberg, Felix (Howard Univ., Washington, D. C.). Radiat. Res., 38: 34-42(Apr. 1969).

Equivalent irradiation in a hydrogen sulfide atmosphere rather than in vacuo causes a diminished aggregation of the S-carboxymethylated ribonuclease and less degradation of the collagen. (auth)

24528 COMPARATIVE ANIMAL EXPERIMENTAL STUDIES ON THE SKIN TEST IN IRRADIATED HAMSTERS. Warnatz, H.; Scheiffarth, F.; Donne, M. (Univ., Erlangen, Ger.). Z. Immunitaetsforsch., Allergie Klin. Immunol., 133: 394-404(Sept. 1967). (In German).

The cutaneous test in irradiated hamsters according to Ramseier and the mixed lymphocyte culture test are examined in guinea pigs for reliability in the prediction of histocompatibility between donor and recipient. The frequently observed wrong predictions and the difficulties in the interpretation of the results make the hamster test not well suited for determination of histocompatibility. On the contrary, the mixed lymphocyte culture test shows a good reliability to select the most promising individual among a panel of possible donors for a recipient. (auth)

24529 CHANGES IN THE BINDING CAPACITY OF THE CORTICOSTEROID-BINDING BLOOD PLASMA GLOBULIN IN ACUTE RADIATION SICKNESS. Moroz, B. B.; Pantyushina, N. N. Byull. Eksp. Biol. Med., 67: 28-30(Jan. 1969). (In Russian).

Results of this investigation of the binding capacity of the corticosteroid-binding globulin of blood plasma in rabbits in acute radiation sickness after gamma-irradiation with a dose of 800 R suggest that the appearance of the free fraction of hormone during the first hours after irradiation is caused by a considerable concentration of the corticosteroids. The dissociation of the protein-steroid complex at the height of the radiation sickness is immediately related to decreased binding capacity of the corticosteroid-binding globulin. (auth)

24530 INVESTIGATIONS ON RADIOINDUCED CHANGES IN NUCLEI ACID METABOLISM OF CHLORELLA PYRENOIDOSA. Fetter, F.; Altmann, H. (Institut fuer Biologie, Seibersdorf, Austria). Bodenkultur, 19: 320-35(Nov. 1968). (In German).

Carbon-14 labeled guanine was incorporated into synchronous chlorella cells and the synthesis of nucleic acid groups was followed by means of the varying incorporation rates and the radiation-dependent supression of this synthesis. It was found that the DNA synthesis reached its maximum after 16 hours (change from light to darkness) and was suppressed by gamma irradiation. In comparison, RNA synthesis which reaches its maximum toward the end of DNA synthesis, was less inhibited by similar dose of gamma irradiation. (auth)

24531 PROTEIN COMPOSITION OF BLOOD SERUM OF RATS DURING INFLAMMATION AT LATE PERIODS AFTER IRRADIATION. Klimovich, V. B. Byull. Eksp. Biol. Med., 67: 30-3(Jan. 1969). (In Russian).

Rats during acute radiation sickness and control animals were injected with turpentine causing aseptic inflammation. Blood serum protein fractions were studied 7 and 10 days later. Rats surviving 10 months after irradiation, as compared with control, had slow increase of alpha-globulin concentration, absence of significant decrease of total prealbumin-albumin fraction and a more marked drop of gamma-globulins. Seventeen months later in irradiated animals no notable shifts in the proteinogram were recorded, while in the control group definite changes were seen in a number of components. As dysproteinemic changes during inflammation have an adaptive character, their slow development or absence in the body is regarded as a manifestation of deficiency in the protective-adaptive mechanisms of irradiated animals. (auth)

24532 ON THE BIOLOGICAL EFFECTS OF ELASTIC NUCLEAR COLLISIONS. II. UNAFFECTABILITY OF THEIR EFFECTS ON RIBONUCLEASE BY CYSTAMINE AND LOW TEMPERATURE. Jung, H. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Naturforsch., 21b: 1165-70(1966). (In German). (KFK-544).

Slow protons having energies below 1.5 keV dissipate their kinetic energy in matter through elastic nuclear collisions. By this process atoms are displaced out from their original positions in macromolecules. This was recently shown to cause biological damage with high efficiency. Experiments are described to test the possibility of modifying the sensitivity of ribonuclease toward elastic collisions by protective agents and by low temperatures. When cystamine is present during irradiation dry ribonuclease is protected against the action of "ionizing" fast protons (2 MeV), the dose reduction factor being 1.8. But no protection is observed when inactivation is achieved by elastic nuclear collisions (proton energy 1 keV and 1.4 keV). Similar results were obtained when the irradiations were carried out at different temperatures. Using 2 MeV protons the radiosensitivity of ribonuclease was found to be 3 times higher at room temperature than at 125°K, but when using slow protons of 1.4 keV energy the inactivation cross section turned out to be independent of temperature. This shows that the action of elastic nuclear collisions can be modified either by cystamine or by low temperatures. (auth)

24533 PHAGOCYTOSIS AND TRANSLOCATION OF $^{239}PuO_2$ PARTICLES BY PERITONEAL PHAGOCYTES OF THE RAT. Sanders, C. L. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Monogr. Nucl. Med. Biol., No. 2, 81-90(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Intra-peritoneally deposited $^{239}PuO_2$ particles were translocated mainly into the mesentericomental region at five to seven hr after particle administration. Phagocytosis of deposited particles was the prime factor involved in the removal of particles from the peritoneal cavity. Significant direct penetration of the peritoneum by particles had probably also occurred during the first hr. Phagocytic and translocative rates were related to particle size. (auth)

24534 TISSULAR DEPOSITION OF RADIONUCLIDES DURING PREGNANCY. Sternberg, J. (Univ. of Montreal). Monogr. Nucl. Med. Biol., No. 2, 91-110(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Some aspects of the deposition of radionuclides during pregnancy were analyzed; the kinetics of deposition is considerably different in the maternal and fetal compartments, because of the distinctive metabolic profiles of the two units. After analysis of the common environmental radiocontaminants from the biological points of view, some specific aspects of the problem were studied, as follows: The hormonal changes undergone by the pregnant organism induced a modification of the excretion pattern of a radiocontaminant and, implicity, of the body burden; such was the case of ^{137}Cs, the urinary and fecal excretion of which are significantly increased during pregnancy, thus inducing a marked shortening of the body burden in guinea pigs. Extrapolation to humans gave comparable results. The retention of ^{137}Cs in the placenta appears to be comparatively less important than in the whole body; measurements of the placental retention in Japanese and Western women failed to show any significant difference related to diet or race, and above all to previous radioactive contamination of the environment. Placentas collected from women from Hiroshima exhibited levels of ^{137}Cs equal to or even less than those collected from other Japanese or Western women. For the moment, placental retention of γ emitting radionuclides does not represent any significant source of fetal irradiation. The kinetics of calcium is modified during pregnancy and lactation; accretion and resorption are moderately increased during pregnancy and markedly increased during lactation, thus facilitating a larger deposition of bone seekers during these situations but also releasing the bone seekers deposited before the pregnancy or lactation. The accretion and resorption of calcium in the fetus are considerably higher than in the mother. Placental permeability for radionuclides ranged from free passage for the natural metabolites to complete impermeability for the lanthanides and transuranic radionuclides circulating in the blood as colloids. The integration of some radionuclides in complex organic molecules brings another change to the rate of transfer, according to the importance of the labeled molecule in maternal and fetal economy. In some cases, the transfer is influenced by the enzymes situated in the placental membrane or by the chelation of the radionuclide. Deposition of radionuclides in the fetus is poorly documented; of importance is the study of the critical organ before and after the functional onset of a given organ (iodine trapping for thyroid, calcification of bone). For a few radionuclides studied, the deposition in fetal organs is comparatively higher than that in the corresponding maternal organs. (auth)

24535 KINETIC STUDIES ON PLACENTAL TRANSFER OF RADIONUCLIDES. Sternberg, J.; Legare, J.-M. (Univ. of Montreal). Monogr. Nucl. Med. Biol., No. 2, 111-23(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Pregnant guinea pigs in the last third of term were used for the study of placental transfer of iodine, calcium, and cesium. One fetus was removed at its placental insertion and replaced by an open circuit perfusion, while the other fetuses of the litter remained intact. Iodine-131 was injected into the mother via the jugular simultaneously with perfusion from the fetal side with ^{125}I; ^{45}Ca or ^{137}Cs was added to either of the isotopes, and the rates of placental transfer were determined in both directions. In the maternal blood, the disappearance rate of the administered isotopes took the form of a multi-exponential curve similar for the isotopes tested. On the other hand, each isotope had a different rate of transfer in the direction mother-to-fetus; the highest transfer rate was found for iodine, 4.7%/hr/fetus, about three times faster than calcium and 13 times faster than cesium. This phenomenon does not reflect the difference in the size of the pools of the respective minerals; it would seem that the placenta exerts a marked discrimination between ^{137}Cs and potassium. There was a concentration gradient for fetal plasma radioiodine, that averaged four to eight times the level of maternal plasma radioiodine; this does not exist for calcium and cesium, which are one-third and one-tenth of the level seen in maternal plasma, respectively. There was a backflow in the direction fetus-to-mother, averaging 25 to 30% of the amount of isotope transferred in the opposite direction. The rate of transfer was independent of the chemical nature of the transferred isotope or the metabolic role played by the corresponding element in fetal economy. It is postulated that the fetal backflow was an additional mechanism to facilitate fetal excretion of a given metabolite, that was not recycled in the fetal circulation. (auth)

24536 ASSESSMENT OF ^{90}Sr BODY BURDENS IN VIVO IN RELATION TO THE METABOLIC TIME COURSE FOLLOWING UNIFORM SKELETAL CONTAMINATION. Della Rosa, R. J.; Goldman, M.; Bustad, L. K. (Univ. of California, Davis). Monogr. Nucl. Med. Biol., No. 2, 152-63(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The utility of bioassay procedures as a dependable indication of ^{90}Sr body burdens is questioned since plasma, urine, and fecal concentrations are continually changing with time following contamination. The growing hair represents the integrated plasma concentration of ^{90}Sr and, therefore, an estimate of exchangeable ^{90}Sr in bone. The concentration of ^{90}Sr in teeth can be utilized to reconstruct the maximum body burden acquired during the time of tooth growth and development. However, in combination with accurate whole-body measurements, bioassay procedures can be useful in evaluating the subsequent hazard associated with the body burden. The pattern of uptake, retention, and long-term dynamics of ^{90}Sr in the Beagle suggest some similarities to those reported for man, and in view of skeletal similarities can assist in furthering our knowledge of bone growth and development, as well as evaluating the hazards, particularly to children, from deposited radionuclides. (auth)

24537 DEPOSITION OF SOME RADON DAUGHTERS (^{210}Po, ^{210}Pb) IN RATS AFTER INHALATION OF RADON, WITH SPECIAL CONSIDERATION OF THE SIMULTANEOUS INFLUENCE OF SiO_2. Kilibarda, M.; Visnjic, V.; Panov, D.; Radovanovic, R.; Novak, Lj. (Inst. of Occupational and Radiological Health, Belgrade). Monogr. Nucl. Med. Biol., No. 2, 222-33(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The distribution of ^{210}Po and ^{210}Pb was studied in experimental rats after inhalation of radon for five- and one-month periods. The highest activity of ^{210}Pb occurred in the skeleton, lungs, and spleen. For ^{210}Po, it occurred in the kidney, spleen, and lungs. The simultaneous effects of radon at 7.36×10^{-6} Ci/l and intratracheally administered SiO_2 were also studied. The radon exposure occurred over a 533-hr period and the quantity of SiO_2 administered was 15 mg per animal. Body weights, lung weights, concentration of SiO_2, quantities of scleroproteins in the lungs, and pathohistologic changes in the lungs were the parameters studied. From the results, it was concluded that radon did not influence the character of experimental silicosis developed in these experiments. (auth)

24538 THE EFFECTS OF SOLUBILITY ON THE BIOASSAY FOR INHALED RADIONUCLIDES. Boecker, B. B.; McClellan, R. O. (Lovelace Foundation, Albuquerque, N. Mex.). Contract AT(29-2)-1013. Monogr. Nucl. Med. Biol., No. 2, 234-42(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Whole body retention, excretion, and tissue distribution data for ^{137}Cs inhaled by dogs as $^{137}CsCl$ or in fused clay particles were reviewed with emphasis on the role of solubility in the behavior of the radionuclide. In $^{137}CsCl$ exposed animals, the ^{137}Cs was distributed throughout the body with whole body being the critical organ. The whole body retention could be described as a sum of three exponentials; the longest component, which represented 77% of the initial body burden, had a biological half-life of 43 days. In the animals exposed to ^{137}Cs in fused clay particles, lung and tracheobronchial lymph nodes contained the highest concentrations of ^{137}Cs with lung considered as the critical organ. Whole body retention of ^{137}Cs was described by a sum of three exponentials with longest component representing 43% of the initial body burden and corresponding to a biological half-life of 440 days. Exposure to equivalent initial body burdens would result in an infinite cumulative tissue ^{137}Cs concentration-time value for lungs that is 520 times that for whole body, the critical organs, respectively, for the "insoluble" and soluble forms of radionuclide. Potential sources of error in hazard assessment using whole-body counting and excreta analysis were discussed based on the aboye example. Repetitive whole-body counting and scanning to determine radionuclide location appear to be techniques that can minimize the potential for error in hazard evaluation for an exposed individual. (auth)

24539 INTERPRETATION OF EXCRETION DATA FROM BEAGLE DOGS AFTER ^{239}Pu INHALATION. Stuart, B. O.; Bair, W. J.; Park, J. F. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Monogr. Nucl. Med. Biol., No. 2, 243-55 (1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Inhalation experiments with beagle dogs using four forms of plutonium oxide and one of plutonium nitrate lead to the following conclusions: Computer analyses showed that the best fitting to a power function relating fecal excretion to whole-body burden was obtained by omitting the first seven or 14 days of fecal excretion values. This is probably because during the first two weeks the rates of clearance from the various portions of the lung were changing rapidly. After this time the fecal excretion of plutonium

probably reflected clearance from the pulmonary lung almost exclusively. Fecal excretion of plutonium in the case of a man who inhaled insoluble plutonium also showed a better fit to a single power function after the first 10 days post-exposure. The curves relating urinary excretion to whole-body burden were not influenced by omitting the values for the first few days, probably because urinary excretion reflected elimination from a single pool; i.e., the systemic burden. The power function type of relationship between percent daily body burden and days after exposure gave a better fit to two-week to three-month values for excretion of inhaled PuO_2 than did either linear or single-exponential relationships. If fecal excretion data do represent clearance from the lung and this excretion after two weeks is best fitted by a power function, then the general practice of using a single half-life to describe slow pulmonary clearance is an over-simplification. These findings provide further support for the use of fecal excretion analysis for the determination of lung burdens of inhaled plutonium. (auth)

24540 ACCELERATING THE TURNOVER OF INTERNALLY DEPOSITED RADIOCESIUM. Richmond, C. R. (Los Alamos Scientific Lab., N. Mex.). Monogr. Nucl. Med. Biol., No. 2, 315-28(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Numerous attempts have been made to accelerate ^{137}Cs turnover from animals and man. These attempts include isotopic dilution, supplementation of K^+ and Cs^+, diuretics, hormones, ion exchangers, chelating agents, and natural food products. None of these materials proved of any significance when used in human subjects. Ferric ferrocyanide, a polymerized super complex, is the first material to effectively accelerate the turnover of internally deposited radiocesium. It is non-toxic and well tolerated. Also, its effectiveness is not dependent on the time when treatment begins, and the effect appears to be proportional to duration of treatment. Body potassium and sodium stores do not appear to be affected by treatment; binding to ferric ferrocyanide is apparently specific for the cesium ion. Ferric ferrocyanide is not absorbed into the body. It preferentially binds cesium ions in the lumen of the gut, thereby interrupting the enteral circulation and preventing re-insorption and deposition in tissues. (auth)

24541 INCREASED EXCRETION OF ^{137}Cs IN HUMANS BY PRUSSIAN BLUE. Stroemme, Aksel (Central Hospital, Karlstad, Sweden). Monogr. Nucl. Med. Biol., No. 2, 329-32(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

On an average, Prussian Blue given orally in doses of one gram three times a day reduced the long-term biological half-life of ^{137}Cs in adult males to one-third of its original value. (auth)

24542 ABSORPTION OF STRONTIUM IN RATS ON ALGINATE SUPPLEMENTED DIET. Harrison, G. E. (Radiobiological Research Centre, Harwell, Eng.). Monogr. Nucl. Med. Biol., No. 2, 333-9(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The additional protection against absorption of Sr provided by dietary supplementation with an oligoguluronide appears to be established. The optimal degree of polymerization of the product has not been obtained so far. Certain initial experiments with oligoguluronides rich in the monomeric form suggests that a polymer is required if absorptive discrimination against Sr is to be achieved. With this limitation, results from in vitro experiments using slices of rat duodenum suggest that the differential uptake of Sr and Ca in the slice is not dependent on the degree of polymerization of the alginate. The protection against Sr absorption by 10% Manucol SS/LD supplementation in rats on a 0.04 g % Ca diet with that in rats on standard cube diet containing 1 g % Ca was compared. The results showed that while the protection against Sr by alginate was some 30% greater in animals on the low Ca diet, the absorption of Ca appeared to be somewhat reduced. (E.R.B.)

24543 ATTEMPTS TO INFLUENCE THE EXCRETION OF PARENTERALLY ADMINISTERED ^{85}Sr IN RATS. Volf, V. (Inst. of Radiation Hygiene, Prague). Monogr. Nucl. Med. Biol., No. 2, 355-60(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

It was shown that pilocarpine stimulated the endogenous fecal ^{85}Sr by enhancing its passage across the intestinal wall, rather than via salivary glands only. Oral pre-treatment with single doses of various absorbable salts resulted in decreased skeletal uptake of injected ^{85}Sr. Urinary excretion of ingested strontium, magnesium and sometimes calcium increased, and ^{85}Sr appeared in urine in a rather constant ratio to the total weight of stable alkaline earths. Although each of the latter may act as "carrier" for ^{85}Sr, it is hardly the only mechanism, as indicated by their varied effects on the retention of ^{85}Sr and on its excretion pattern. The importance of the anion was illustrated by the results following the administration of sulphates and phosphates. The effect of strontium- and calcium chlorides appeared to be dependent upon age. (auth)

24544 THE INFLUENCE OF HORMONES ON THE UPTAKE AND LOSS OF ^{89}Sr IN MOUSE BONE. Woodard, H. Q. (Sloan-Kettering Inst., New York). Monogr. Nucl. Med. Biol., No. 2, 361-71(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The growth in length and the net storage of mineral in the tibias of female albino mice between 40 and 140 days of age were compared with the retention of ^{89}Sr by the same bones four hrs and 48 hrs after intraperitoneal injection. In two series of normal mice a stressful environment was associated with a decrease in net mineral storage and an increase in both uptake and loss of ^{89}Sr. In hyperthyroid mice both net storage of mineral and ^{89}Sr retention were impaired. In estrogen-treated mice net storage of mineral was greatly increased and this was associated with a decreased rate of loss of ^{89}Sr. In hydrocortisone-treated mice net storage of mineral was decreased and rate of loss of ^{89}Sr was increased. (auth)

24545 EXPERIENCES IN THE REMOVAL OF RADIOACTIVE STRONTIUM FROM ANIMALS BY MODIFYING PHYSIOLOGICAL PARAMETERS. Smith, H. (Technical Coll., Sunderland, Eng.). Monogr. Nucl. Med. Biol., No. 2, 372-85(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Many substances known to inhibit new bone growth, to accelerate resorption, and to block renal and intestinal reabsorption of alkaline earth metals were tested. Only a few have shown a positive response. Fluoride and one of the polyphosphates tested did inhibit uptake of ^{85}Sr into bone. Although no toxic reactions were observed, much further work on toxicity must be done before such techniques could be used in the human. As a combined therapy in rats, citrate was injected intraperitoneally within 30 min of ^{85}Sr, followed by stable strontium chloride and sodium salicylate for several days. Both substances were effective in reducing the retention of ^{85}Sr. However, salicylate can cause gastric irritation and the long-term effects of stable strontium and alginate are unknown. (E.R.B.)

24546 ASSESSMENT OF DEPOSITED RADIOSTRONTIUM DURING CHILDHOOD. Wellman, H. N.; Kahn, B.; Salem, A. J.; Robbins, P. J. (National Center for Radiological Health, Cincinnati). Monogr. Nucl. Med. Biol., No. 2, 386-94(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Balance data on six six-yr-old and nine nine-year-old children for Ca, ^{90}Sr, Sr, and P were intercompared with results from the previous study of 30 normal infants. Extreme variabilities were found in the observed ratio (OR) values. A marked difference in the behavior of ^{90}Sr compared to stable strontium from normal diets was suggested. Poor correlation of ^{90}Sr balance with either Sr or Ca data indicated a need to regard ^{90}Sr metabolism as a separate entity. It is suggested that appropriate fractional absorption and retention values (f_1 and f_2 of the ICRP report) be used in conjunction with appropriate effective half-lives of ^{90}Sr and up-to-date dietary information on ^{90}Sr levels as a simple practical means of assessing radiostrontium deposition in man. (auth)

24547 TREATMENT OF PLUTONIUM-CONTAMINATED WOUNDS WITH DIETHYLENETRIAMINEPENTAACETIC ACID IN RATS. McClanahan, B. J.; Kornberg, H. A. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Monogr. Nucl. Med. Biol., No. 2, 395-402(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

A study of the tissue distribution and excretion pattern of plutonium, chelated by DTPA prior to its subcutaneous administration is described. Effectiveness of DTPA as an irrigant for wounds contaminated with plutonium as the nitrate, citrate, or dioxide is presented. These compounds were selected because of the differences in their chemical properties. (auth)

24548 COMBINED RETICULOENDOTHELIAL STIMULATION AND LONG-TERM, INTERMITTENT DTPA THERAPY IN POISONING BY POLYMERIC PLUTONIUM. Rosenthal, M. W.; Smoler, M.; Lindenbaum, A. (Argonne National Lab., Ill.). Monogr. Nucl. Med. Biol., No. 2, 403-12(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Mice were given a single intravenous injection of 0.1 or 0.2 μCi of polymeric plutonium, about 30% ultrafilterable, and ungraded as to particle size. Beginning five days later they were given 40 mg/kg of the reticuloendothelial system stimulant, glucan, once daily for three days, or 500 mg/kg of DTPA, once every three days for 28 injections, or both treatments. In mice given glucan alone there was no effect on the plutonium content of any tissue at the height of the reticuloendothelial stimulation. Near the end of the period of stimulation (41 to 49 days after plutonium), the liver content of plutonium was lower (by about 10% of the injected dose) than the level in controls, and the bone content was increased by about the same amount. In mice given DTPA alone the liver content of plutonium was reduced by about the same amount, and the bone burden was reduced to 30% of the control level by 89 days. Combined, the two treatments had a nearly additive effect in reducing the liver burden and the same effect in bone as DTPA alone. Autoradiograms of livers showed that both glucan and DTPA reduced the concentration of plutonium in the hepatic parenchyma to a greater extent than in the sinusoidal areas. Concentrations of single α tracks and of stars, representing larger plutonium deposits, were reduced. In addition, in glucan-injected mice either with or without DTPA, the plutonium aggregates appeared more diffuse and disorganized than normal. These results suggest that these glucan-induced aggregates break up easily and permit more plutonium to be removed by natural mechanisms or therapeutic agents such as DTPA. (auth)

24549 INTERACTION BETWEEN CHELATES AND ENDOGENOUS ZINC. Catsch, A.; Harmuth-Hoene, A.-E.; Havlicek, F.; Carpy, S. (Kernforschungszentrum, Karlsruhe, Ger.). Monogr. Nucl. Med. Biol., No. 2, 413-18(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Some quantitative aspects of the interaction between chelating agents and endogenous zinc were investigated using ^{65}Zn. Rats were injected with carrier-free ^{65}Zn and after different time intervals with the Ca-chelates of EDTA and DTPA. Excretion rates were determined for endogenous Zn following chelation with EDTA or DTPA. (E.R.B.)

24550 METABOLISM AND REMOVAL OF SOME RADIOISOTOPES IN MAN. Spencer, H. (Veterans Administration Hospital, Hines, Ill.). Contract AT(11-1)-1231-34. Monogr. Nucl. Med. Biol., No. 2, 489-520(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The metabolism of some radioisotopes in man and methods of their removal were reviewed. The urinary excretion of the radioisotopes, ^{140}La, ^{90}Y, ^{46}Sc, ^{65}Zn, ^{85}Sr, and ^{90}Sr could be increased by various means while the compounds used failed to increase the excretion of ^{137}Cs. The chelating agents EDTA and DTPA were effective in increasing the excretion of the elements of the rare earth series and of ^{65}Zn and DTPA was more effective than EDTA in the removal of these elements. The enhanced excretion of radiostrontium was usually associated with an increase in urinary calcium excretion that was induced by the various agents used in the enhancement studies; however, the removal of radiostrontium seemed to depend on its localization in the skeleton and on the mechanism by which the enhancing agents increased the urinary calcium excretion. For instance, an increase in excretion of chronically ingested ^{90}Sr could not be achieved by some methods that increased the excretion of recently administered ^{85}Sr, probably due to the fact that ^{90}Sr is localized in deeper, inaccessible areas of the skeleton than acutely administered ^{85}Sr. (auth)

24551 DNA DEGRADATION IN ESCHERICHIA COLI 15T$^-$L$^-$ INDUCED BY FAST PROTON BOMBARDMENT. Huston, D. C.; Pollard, E. C. (Pennsylvania State Univ., University Park). Biophys. J., 7: 555-65(1967). (NYO-2804-15).

Degradation of DNA and its temperature dependence as a function of LET were studied in Escherichia coli using fast proton irradiation. The data indicate that radiation-induced DNA degradation can proceed by two processes. The first, or fast component, begins immediately after irradiation with ^{60}Co γ-rays or with fast protons at doses less than 10^{10} protons/cm^2. The rate is high and involves a maximum of about 50% degradation. It is elicited more efficiently by protons of high linear energy transfer. The second, or slow component, results from higher doses of fast proton bombardment. There is a delay between irradiation and the initiation of this slower component, but 100% of the DNA complement is degraded. The data indicate that both processes are enzyme-mediated, the first probably by normal DNA-related activity and the second by DNAase activity. (auth)

24552 COMPARATIVE LOCALIZING RESPONSE OF INFLAMMATORY AND IRRADIATED TISSUES TO INJECTED PROTEIN. Kahn, Reuben L.; Botzler, Richard G.; Miller, Norman S. (Univ. of Michigan, Ann Arbor). Contract AT(11-1)-1172. Proc. Soc. Exp. Biol. Med., 124: 153-4(1967). (COO-1172-9).

A restricted dose of diphtheria antitoxin was injected subcutaneously in corresponding areas in 3 groups of rabbits for the neutralization of a lethal dose of toxin. In one group, the antitoxin was injected in an x-irradiated area; in another, in an inflammatory area; in a third, in a normal area. It was found that the rabbits in which the antitoxin was injected in the inflammatory area showed the least protection from the toxin, indicating that the antitoxin became localized in situ and was not able to reach the toxin fast enough for neutralization. The rabbits in which the antitoxin was injected in the irradiated area showed the greatest protection from the toxin, indicating that the antitoxin escaped from the injected area, reached the toxin and neutralized it. These differences in localization between the irradiated and inflammatory areas compared with the controls were found to be statistically significant. (auth)

24553 EFFECTS OF ERROR ON COMPARTMENTAL ANALYSIS. Myhill, J. A. (Royal North Shore Hospital, Sydney). Dig. Int. Conf. Med. Biol. Eng., 7th, Stockholm, 1968 (1967).

Effects of data errors and omissions on the model parameters of a steady state system and the calculation of the compartmental transfer rates of administered radioactivity are discussed. Simulated data points and variables used on a high speed digital computer using the equation for f(t) and some random number generators included the number of exponential components, the numbers and values of the decay parameters, λ_i the time interval, the number of data points in this interval, the spacing of the data points, the magnitude of the error in the data, the statistical distribution of the error in the data, and the variation of the error over the interval. The function was fitted to each set of data using a valid least squares gaussian iterative technique, and the estimated values with their estimated standard deviations were obtained. Each set of data was simulated many times and from this the variability and bias of the estimates and their standard deviations were studied. The maximum amount of error in the data that permitted convergence of the numerical technique was 1, 5, and 10% when the ratio of each $2\lambda_i$ was 2, 4, and 6, respectively. With high data errors and few points a consistent underestimate was found which averaged 20%. The average standard deviation of λ_1 and λ_2 ranged from 3 to 50% being greater for the lesser λ_i. If the data were analyzed under a mistaken assumption of constant SD error in data, instead of constant percent SD, the parameter SD's were overestimated. (BBB)

24554 FUNCTIONAL AND ULTRASTRUCTURAL STUDIES OF ANTIBODY-PRODUCING CELLS EXPOSED TO 10 000 R IN MILLIPORE DIFFUSION CHAMBERS. Sado, Toshihiko (Oak Ridge National Lab., Tenn.). Int. J. Radiat. Biol., 15: 1-22 (1969).

Antibody-producing plasma cells in millipore diffusion chambers continue to synthesize specific antibodies for several days after exposure to 10,000 R. Three out of ten nucleated cells were found to be specific antibody producers 4 days after exposure to x-rays, whereas in the unirradiated control only one out of ten was an antibody-producing cell. The half-life of irradiated antibody-producing cells was not different from that of unirradiated cells. Autoradiographic studies revealed that a significant number of immature plasma cells were synthesizing DNA as late as 15 days after irradiation. However, these DNA-synthesizing cells did not represent a proliferating cell fraction, because after irradiation there was apparently no progression of cells through the cell-cycle. Electron microscopic studies showed that fully developed endoplasmic reticulum rich in ribosomes and Golgi complex remained intact, whereas nuclear damage was pronounced. Ruptured plasma membranes and swelling of mitochondria were found frequently in the irradiated population when the cells were fixed with Palade's fixative alone, but not when fixed with combined 2.5 percent glutaraldehyde and Palade's fixative. (auth)

24555 FORMATION OF THYMYL RADICALS IN GAMMA-IRRADIATED FROZEN AQUEOUS SYSTEMS: AN E.S.R. STUDY. Srinivasan, V. T.; Singh, B. B.; Gopal-Ayengar, A. R. (Bhabha Atomic Research Centre, Bombay). Int. J. Radiat. Biol., 15: 89-93(1969).

Free radicals form in thymine as a result of reactions of trapped electrons produced by γ irradiation of frozen alkaline aqueous solutions at 77°K. These electrons have been detected by electron spin resonance spectroscopy and optical absorption techniques and have properties similar to the hydrated electrons formed during water radiolysis. The effects of warming and photobleaching on the yield of thymine radicals are described. (M.M.B.)

24556 X-RAY INACTIVATION OF LYSOZYME IN DILUTE SOLUTION. Gorin, G.; Papapavlou, L.; Tai, L. W. (Okla-

homa State Univ., Stillwater). Int. J. Radiat. Biol., 15: 33-41 (1969).

The inactivation of lysozyme was measured in the following conditions: 40–500 μg/ml. in 0.05 M phosphate buffer, pH 6 to 7, 0°C, in the presence of air. The activity decreased linearly with the dose to <25 percent residual activity. The yield was 0.18 molecules/(100 eV). p-Aminobenzoic acid, cysteine and phenylalanine have a protective action, which parallels their rates of reaction with (OH·) radicals; this indicates that (OH·) is primarily responsible for inactivation of the enzyme. The meaning of the activity-dose relationship and the value of the yield are discussed. (auth)

24557 MECHANISM OF PHOTOREACTIVATION OF PSEUDORABIES VIRUS. Pfefferkorn, E. R. (Dartmouth Medical School, Hanover, N. H.); Coady, Helen M. J. Virol., 2: 474-9 (May 1968).

In microbial systems photoreactivation was shown to involve the splitting of uv-induced pyrimidine dimers by a light-dependent enzyme. Data reported here implicate this mechanism in the photoreactivation of a herpes virus, and show that the ability to perform photoreactivation appears to be determined by the cell rather than by the virus. Primary chick embryo cultures were able to photoreactivate uv-inactivated pseudorabies virus. Upon exposure to fluorescent light, infected or uninfected chick cells eliminated thymine dimers induced in their DNA by uv irradiation. In contrast rabbit kidney cells did not photoreactivate the virus or eliminate thymine dimers. Thus, the capacity for photoreactivation appeared to be determined by the ability of the cell to eliminate thymine dimers. (BBB)

24558 STUDIES ON CARBOHYDRATE METABOLISM WITH LABELED HYDROGEN. VI. TRITIUM FIXATION IN ETHANOL AND LACTIC ACID AFTER FERMENTATION OF GLUCOSE IN H_2O/THO OR OF TRITIUM-LABELED GLUCOSES BY LEUCONOSTOC MESENTEROIDES. Rauschenbach, Peter; Simon, Helmut (Technische Hochschule, Munich). Z. Physiol. Chem., 349: 1330-6(Oct. 1968). (In German).

Various strains of Leuconostoc mesenteroides were incubated with 5 glucoses, which were labeled in the 1-, 2-, 3-, 4-, or 5-position. More than 90% of the hydrogen atoms attached to C-1 and C-3 of the glucose were transferred via pyridine nucleotides forming the methylene group of ethanol (ADH- and AcR-hydrogen) of D-lactate from pyruvate (LDH-hydrogen). ADH, AcR, and LDH hydrogens refer to hydrogen atoms arising from reduced pyridine nucleotide by the action of alcohol dehydrogenase, aldehyde dehydrogenase, and lactic dehydrogenase. There is a preferential utilization of hydrogen from C-1 for the ADH-hydrogen of ethanol. When 4-T glucose was used, no tritium was fixed in the products. It appears quantitatively in the water. This corresponds to the observation that, after fermentation in H_2O/THO, about 80 to 85% of the tritium of the hydrogen of the water is fixed in the position transferred by pyridine nucleotides. The tritium content of 2-T glucose appears nearly quantitatively in the methyl group of ethanol. From H_2O/THO about 65% tritium is fixed in the methyl group of ethanol and an average of 32% in the methyl group of the lactate. (BBB)

24559 IN VITRO AND IN VIVO CYTOLOGIC AND ENZYME STUDIES ON THE DYNAMICS OF CELL POPULATIONS OF GYNECOLOGICAL TUMORS AND ON ATYPIA FOR DETECTION OF THEIR PROSPECTIVE POTENCY. Paeschke, Karl-Dietrich (Univ., Goettingen, Ger.). Krebsforsch. Krebsbekaempf., 6: 161-5(1967). (In German).

Relative equilibria between healthy and carcinomatous cells were altered by means of irradiation in vivo with therapeutic doses of Ra and ^{60}Co γ radiation, and observed subsequently in vitro. One type of resistant nuclear type exhibited a strong tendency to spread and reproduced the original polymorphy. Following combined treatment of patients with the cytostatic agent proresid, ^{226}Ra, and ^{60}Co irradiation the serum lactic dehydrogenase and malic dehydrogenase activities were decreased by ~50% over a period of 4 days. (BBB)

24560 IN VIVO RESPONSES OF HUMAN LYMPHOCYTES TO PPD: THE USE OF A LIQUID SCINTILLATION TECHNIQUE. Thurmon, T. F.; LaPolla, J. J.; Kent, D. C. (Naval Hospital, St. Albans, N. Y.). Amer. Rev. Respirat. Dis., 98: 501-4(Sept. 1968).

A method was developed for studying in vivo uptake of tritium-labeled thymidine by human lymphocytes reacting to antigen by the assay of lymphocytes for tritium with a liquid scintillation counter spectrometer. Lymphocyte DNA synthesis was determined after intradermal injection of purified protein derivative (PPD) of human tubercle bacilli strain H37Rv, the reaction being followed by a liquid scintillation technique. It was found that samples prepared by methods described in the literature rapidly deteriorated in radioactivity. Cellular solvents seemed responsible. Therefore, a method was devised in which the cells were fixed in the intact state. This introduced a quenching error, but gave stable samples with reproducible readings. With this method, after administration of H37Rv PPD, there was a brief increase in lymphocyte DNA synthesis in most sensitized subjects. In most nonsensitized subjects, the rate of DNA synthesis increased gradually over a 10-day period. The responses appear to represent basic aspects of the cellular antibody system. (BBB)

24561 LIPID BIOSYNTHESIS BY RADIORESISTANT AND RADIOSENSITIVE YEASTS. Larikova, G. A.; Gal'tsova, R. D. (Inst. of Microbiology, Moscow). Microbiology (USSR) (Engl. Transl.), 37: 362-6(May-June 1968).

A study was made of how the biosynthesis of lipids in general and of sterols in particular varies as a function of x irradiation dose in yeasts differing greatly in radiosensitivity. Four yeast species differing markedly in radiosensitivity were used. Two (Torulopsis utilis and Saccharomyces vini) were radioresistant, while T. spherica and S. lactis were radiosensitive. The LD_{50}'s for radiosensitive cultures were about one-tenth of those for the radioresistant cultures. X irradiation of yeast cultures usually leads to excessive accumulation of lipids, including sterols, in the cells, which continue to grow and reproduce on nutritive media. Radiosensitive and radioresistant yeasts differed markedly in their lipid-accumulation rates and maximum lipid contents after irradiation. A marked increase in lipid and sterol contents over those of unirradiated control cells began at a lower irradiation dose for radiosensitive cultures. Regardless of the irradiation dose, the lipid content of radiosensitive cultures was higher than that of radioresistant cultures. At moderate irradiation doses, lipid synthesis was almost twice as great in radiosensitive as in radioresistant cultures. The greatest increase in sterol content in radiosensitive cells occurs at higher doses. (BBB)

24562 THE INFLUENCE OF SYMPATHOMIMETIC DRUGS AND VAL^5-HYPERTENSIN II-AMINE ON THE MEMBRANE PERMEABILITY FOR ^{86}Rb IN ISOLATED GUINEA PIG ATRIA. van Zwieten, P. A. (Univ., Kiel). Arch. Pharmakol. Exp. Pathol., 261: 441-57(Nov. 12, 1968). (In German).

A method was developed to allow quantitative determination of the membrane permeability in guinea pig atrial tissue using ^{86}Rb. For this purpose ^{86}Rb is easier to handle than the short-lived hard γ emitter ^{42}K. The influence on membrane permeability and ^{86}Rb efflux of some sympathomimetic drugs and that of synthetic angiotensin II were estimated. All experiments were carried out on isolated electrically driven guinea pig atria, incubated in K^+-free Tyrode solution that contained 2.7 mmole Rb^+/l. Directly acting sympathomimetic drugs gave rise to a dose dependent increase of membrane permeability, which is not related to the positive inotropic or chronotropic actions of these drugs. β-Sympatholytic agents (Kö 592 and propranolol) in low dosage (10^{-8} mole/l) did not affect the membrane permeability as such, but strongly inhibited the effect of isoproterenol on this parameter. Phentolamine (10^{-5} mole/l) neither influenced the membrane permeability nor the effect of noradrenaline. The increased membrane permeability for $^{86}Rb^+$ ions during exposure to sympathomimetic drugs seemed to be related to the stimulation of the β-receptors in atrial tissue. In higher concentrations (10^{-5} mole/l) the quinidine-like actions of the β-sympatholytic agents were accompanied by a significant decrease in membrane permeability. Sympathomimetic agents with indirect or mixed actions, like tyramine, ephedrine, and octopamine also caused an increase in membrane permeability for ^{86}Rb. Val^5-hypertensin II-amide (synthetic angiotensin II) caused a dose-dependent increase of the membrane permeability for $^{86}Rb^+$ ions. The effect was but partly reduced by reserpine pretreatment. (BBB)

24563 THE ROLE OF RADIOIODINATED HUMAN SERUM ALBUMIN PLACENTOGRAPHY AND AMIDOTRIZOATE ANGIOGRAPHY DURING PREGNANCY IN THE ASSESSMENT OF THE NEWBORN PROTEIN-BOUND IODINE. Similae, Seppo; Rosberg, George; Pystynen, Paavo (Univ. of Oulu, Finland). Ann. Paediat. Fenn., 13: 96-9(1967).

Metabolism of radioiodine and stable iodine in the newborn as affected by the use of radioiodinated human serum albumin (RISA) in isotopic placentography during pregnancy was investigated. RISA penetrates the placenta minimally. With 5 μCi RISA used in placentography, only 0.006 μCi ^{131}I crosses the placenta. This amount is so small that the fetal irradiation is negligible, but ^{131}I together with the iodine used to block the thyroid before the examination may alter the protein-bound iodine (PBI) of the newborn. The effect of RISA placentography and iodine-containing amidotrizoate (Urografin) angiography during pregnancy in the assessment of the PBI of the newborn was studied. The results showed that RISA placentography performed during pregnancy

may reduce considerably the maternal PBI level at the time of delivery, apparently as a result of the relatively large dose of iodine used to block the thyroid. Very little iodine, only about 1%, is liberated from RISA, a negligible amount. Apparently the pooling of iodine in maternal thyroid is very fast, and the amount of iodine penetrating the placenta is so small that it produces no change in the umbilical blood PBI. When the mother undergoes contrast medium radiography using amidotrizoate immediately postpartum, the PBI of the newborn cannot be used as an index of the infant's thyroid function during the first 6 months of life. (BBB)

24564 THYROIDAL ^{131}I UPTAKE AND TSH POTENCY OF THE PITUITARY IN RESPONSE TO GRADED DOSES OF METHYLTESTOSTERONE IN MYSTUS VITTATUS (BLOCH). Singh, T. P. (Univ. of Udaipur, Rajasthan, India). Gen. Comp. Endocrinol., 11: 1-4(Aug. 1968).

The effects of graded doses of methyltestosterone upon thyroidal radioiodine uptake and thyrotropin (TSH) potency of the pituitary in a freshwater catfish were studied. A dose of 50 μg/fish, given twice a week for 3 weeks, had no effect on ^{131}I uptake. The optimum dose that gave maximum response was 150 μg/fish. There was no significant difference between the TSH potency of the pituitaries of different groups that received varied doses of methyltestosterone. The potency of the experimental groups was comparable with the control group. In Mystus vittatus methyltestosterone appears to stimulate thyroid activity directly, thereby increasing its binding of radioiodine. This stimulation of thyroid activity seems to be independent of pituitary TSH. (BBB)

24565 PHOTOCHEMICAL YIELDS IN RIBONUCLEASE AND OXIDIZED GLUTATHIONE IRRADIATED AT DIFFERENT WAVELENGTHS IN THE ULTRAVIOLET. Rathinasamy, T. K.; Augenstein, L. G. (Michigan State Univ., East Lansing). Biophys. J., 8: 1275-87(Nov. 1968).

The quantum yields for the disruption of various amino acids in glutathione and ribonuclease (RNAase) by 229, 254, 265, and 280 nm uv photons were determined. The results of the measurements on the destruction of tyrosine and histidine and the loss of enzymic function in RNAase and the disruption of cystine in both compounds indicated that the photodestruction of some and perhaps many constituent amino acid residues does not cause RNAase inactivation. Contrary to the basic premise of proposals made by other authors, the photochemical yields of constituent residues in a protein are not the same as that for the same amino acids in solution alone, the difference being a function of the exciting wavelength. Further, the extent of histidine destruction varies by a large factor among three proteins. Consistent with previous predictions, the results show that uv photons absorbed in the aromatic residues of RNAase cause the disruption of cystines elsewhere in the enzyme. Although cystine disruption appears to be the most prevalent mode of RNAase inactivation by photons of the four wavelengths studied, some of the minor mechanisms leading to loss of enzymic function may vary with the uv energy. (BBB)

24566 STUDIES ON MODE OF ACTION OF POTASSIUM IODIDE UPON SPOROTRICHOSIS. Wada, Reigo (Nihon Univ., Tokyo). Mycopathol. Mycol. Appl., 34: 97-107(Mar. 22, 1968).

The incorporation of radioiodine by fungus cells was used to study the effects of iodine on Sporotrichum schenckii. To a patient with sporotrichosis, 200, 100, and 100 μCi of ^{131}I were given perorally on the 14th, 15th, and 16th day respectively after the oral administration of a total 15 g potassium iodine for 13 days. Immediately after the last administration of the isotope, tissue specimens were sampled from lesions. Microscopic observation was made at 400-fold magnification and autoradiography performed. Silver particles were observed in the specimens but it was impossible to determine that the particles corresponded exactly to free fungal spores. In the next experiment, to a culture in Sabouraud's broth was added 50, 100, or 200 μCi of ^{131}I and the cultures were kept at 27°C. The fungal masses were sampled each day, washed with physiological saline, and examined by autoradiography. Many positive dots and lines representing silver were noted in accordance with the presence of hyphae and spores. Such findings were not obtained on control preparations. Growth inhibition of S. schenckii was observed when potassium iodide or iodine-potassium iodide were added to Sabouraud's medium. The inhibition occurred also after the fungus was brought into contact with the compounds before inoculation. Iodine-potassium iodide was more effective on the the inhibition than potassium iodide. These results, combined with the demonstrated uptake of ^{131}I by the fungus, suggest that the effect of iodine compounds on sporotrichosis is due to a direct fungicidal action of iodine. (BBB)

24567 DISCRIMINATION BETWEEN CALCIUM AND STRONTIUM IN OAT PLANTS. I. INFLUENCE OF THE GROWTH STAGE OF THE PLANTS AND OF THE OSMOTIC POTENTIAL OF THE ROOT MEDIUM. Ringoet, A.; de Zeeuw, D. (EURATOM–ITAL, Wageningen, Netherlands). Z. Pflanzenphysiol., 59: 238-48(Aug. 1968).

The ^{45}Ca and ^{85}Sr uptake, transport, and distribution, for varying values (mannitol concentration) of the root medium, was studied in young and flowering oat plants (Avena sativa). Uptake in the low osmotic treatments (0.5 to 7.5 atm) was not reduced. A marked inhibition of uptake was observed at higher osmotic values (7.5 to 12.5 atm). The rate of uptake also varied with the osmotic value of external solution. The uptake and transport for both radioelements seemed to be consistent with a mechanism conditioned by exchange reactions in the conducting tissue. The exchange sites may also be the sites of discrimination. Discrimination against Sr exists in the various serial parts of young plants and to a smaller extent also in flowering plants. Discrimination always increases at high osmotic value of the external solution. It is suggested that discrimination in the high osmotic treatments is not conditioned by the transpiration water flow but results from a relatively smaller root uptake of Sr, which is due to its selective retention in the apparent free space of the roots or to its differential leakage from the root into the root medium. (BBB)

24568 INFLUENCE OF IONIZING RADIATIONS ON THE DECOMPOSITION AND ACCUMULATION OF RESERVE CARBOHYDRATES AND STEROL BIOSYNTHESIS IN YEAST ORGANISMS. Lyapunova, T. S.; Gal'tsova, R. D. (Inst. of Microbiology, Moscow). Microbiology (USSR) (Engl. Transl.), 37: 225-8 (Mar.-Apr. 1968).

Changes in the content of reserve carbohydrates were studied in irradiated yeast cells especially after successive incubation of the cells under conditions favorable for the accumulation of sterols, i.e., in the presence of an exogenous source of carbon (glucose). When Saccharomyces cerevisiae cells were x irradiated, a decrease was noted in the rate of accumulation of glycogen by the yeast while incubated in solutions of glucose. The glycogen content in irradiated cells was 25 to 30% lower than in nonirradiated control cells. The amount of trehalose, contrary to the glycogen content in the irradiated yeasts, increased by 40 to 50%. The uptake of glucose from an aqueous solution of it by irradiated cells was 15 to 20% lower than that by nonirradiated cultures. After the action of ionizing radiations, sterol biosynthesis by yeast cells was substantially intensified. The amount of sterols in the irradiated cultures was doubled or tripled if culture media with a large carbohydrate content was used. (BBB)

24569 PROTECTION OF IMMUNE IRRADIATED RATS FROM TUMOR REGROWTH BY ALLOGENIC SENSITIZED SPLENIC CELLS. Austin, Stephen M.; Brown, Leon; Stark, Alan; Cave, Alfred; Gardner, Bernard (State Univ. of New York, Brooklyn). J. Surg. Res., 8: 326-33(July 1968).

A model was developed for the evaluation of the effects of sensitized allogenic lymphocytes in protecting irradiated rats from regrowth of Walker sarcoma. Between 90 and 100% of rats sensitized to Walker sarcoma reject a reinjection of 500,000 cells. Failure to reject this reimplantation was considered an end-point to judge the development of chimerism. The experiments were designed to demonstrate protection from regrowth of tumor in the rat radiation chimeras by immune allogenic splenic cells. Doses of x radiation above 700 R were rapidly lethal while doses of 700 R and less were better tolerated in 60% of the animals. Peripheral leukocyte depression was not relieved by splenic cell infusion but maintenance of splenic red pulp and development of nodules of plump young lymphocytes were uniformly demonstrated. Interference with immune response by irradiation was demonstrated by failure of the animals to reject a second challenge of Walker sarcoma cells. Significant protection against tumor growth was demonstrated after infusion of 2 million splenic cells from sensitized animals, as compared to cells from nonsensitized donors. (BBB)

24570 FORMATION OF A HISTIDINE–PEROXIDE ADDUCT BY H_2O_2 OR IONIZING RADIATION ON HISTIDINE: CHEMICAL AND MICROBIOLOGICAL PROPERTIES. Schubert, Jack; Watson, Joseph A.; Baecker, Janet M. (Univ. of Pittsburgh). Int. J. Radiat. Biol., 14: 577-83(1968).

It was found that small amounts of hydrogen peroxide in the presence of histidine strongly inhibited the growth of Salmonella typhimurium in glucose medium (pH 7.0). Other amino acids and analogs, e.g. imidazole, alanine, and histamine, were relatively or completely inactive under the same conditions. It was also found that gamma-irradiated oxygenated solutions of histidine inhibit bacterial growth to an extent proportional to the amount of H_2O_2 produced radiolytically. In the glucose-containing microbiological growth medium (pH 7.0, t = 37°C), the presence of histidine greatly retarded the normal rate of disappearance of added H_2O_2. These and other chemical and microbiological observations re-

ported here suggest that histidine and H_2O_2 readily form a stable adduct. A histidine–peroxide crystalline adduct has been prepared and chemically characterized previously. The preparation of other amino-acid–peroxide adducts has also been described. (auth)

24571 LACK OF IN VITRO REPAIR OF X-RAY-INDUCED CHAIN BREAKS IN DNA BY THE POLYNUCLEOTIDE-JOINING ENZYME. Kapp, Daniel S.; Smith, Kendric C. (Stanford Univ., Calif.). Int. J. Radiat. Biol., 14: 567-71(1968).

The polynucleotide-joining enzyme does not repair (in one step) the single-strand chain breaks produced in DNA by x-irradiation in aqueous media. Preliminary data on the chemical nature of the ends of the broken strands suggest that nuclease action (to "clean" the termini), followed by polymerase action, is necessary before the irradiated DNA would become a substrate for the polynucleotide-joining enzyme. (auth)

24572 FREQUENCY OF SINGLE-STRAND BREAKS PER LETHAL γ-RAY HIT IN OX 174 DNA. Lytle, C. David; Ginoza, William (Pennsylvania State Univ., University Park). Int. J. Radiat. Biol., 14: 553-60(1968).

The frequency of sugar-phosphate backbone breaks in single-stranded ØX 174 DNA induced by γ-rays under conditions of direct radiation action is 0.26 ± 0.03 per lethal event and per primary ionization in the DNA. (auth)

Ecology

Refer also to abstracts 24111, 24609, 24711, and 24766.

24573 (A-AC-82/G/L-1243) BIOLOGICAL MIGRATION OF RADIO-NUCLIDES IN FRESH AND SALT WATER RESERVOIRS. Polikarpov, G. G.; Parchevskii, V. P.; Sokolova, I. A.; Timoshchuk, V. I.; Rozhanskaya, L. I.; Ryndina, D. D.; Bachurin, A. A.; Kalninya, Z. K. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1968. 30p. (In Russian). Dep.

Separate abstracts were prepared for the five chapters of this report. Various aspects of radioecology of fresh and salt water are considered. (H.L.W.)

For abstracts of individual chapters see: 24499, 24574–24576, and 24604.

24574 (A-AC-82/G/L-1243, pp 6-10) ^{90}Sr IN THE DANUBE RIVER AND THE ADJOINING INTERNATIONAL ZONE OF THE BLACK SEA. RADIOECOLOGICAL STUDY. Polikarpov, G. G.; Timoshchuk, V. I.; Sokolova, I. A.; Parchevskii, V. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). (In Russian).

Up to now, the radioecology of organisms in the Danube River has not been sufficiently well studied; only the artificial radioactivity of the Danube bacterioplankton, including the ^{90}Sr activity has been determined previously during the 1961-63 period. In this study, the ^{90}Sr and the corresponding ^{90}Y content of fresh and seawater samples and of the ashes of planktons was determined with a mean error of 10 to 15%. Comparison of the earlier 1961-63 data and the authors' results for 1966-67 revealed that the ^{90}Sr content of the water increased, as was observed in other river studies. The results were confirmed by measurement of the ^{90}Sr content of the Black-Sea mussel as a function of time. In the Danube delta area the ^{90}Sr content was found to decrease with the distance. The accumulative ability of hydrobionts for ^{90}Sr is indicated by the buildup factors found: Trapa natans—10; Gobius kessleri—30; Mytilus galloprovincialis—82; Ulothrix tenuissima—211. It is concluded that a complete isotopic exchange takes place between ^{90}Sr and the stable Sr in the Black Sea plants and animals. The presence of ^{90}Sr is attributed to the world-wide radioactive fallout. (TTT)

24575 (A-AC-82/G/L-1243, pp 11-20) ROLE OF CERTAIN MARINE ORGANISMS IN THE MIGRATION OF MANGANESE, COPPER, AND ZINC IN THE SEA OF AZOV. Rozhanskaya, L. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). (In Russian).

Samples of water, plankton and benthonic deposits and organisms, collected in the Sea of Azov during June and October, 1964, and April, 1965, were analyzed, determining the chemically bound or occluded contents of manganese, copper, and zinc. Although the concentrations were very low, the calculations indicated that the Sea of Azov contains considerable amounts of these elements. The microelement concentrations in the plankton were found to increase considerably during the autumn; this is caused by the increase of the biomass of phytoplankton. The biogenic migration of these elements, especially that of zinc, is thus subjected to seasonal variations. Similar experiments were carried out for the benthonic organisms, Nephthys hombergii and Nereis succinea. The calculated buildup factors indicated that the plankton concentrates manganese 200 to 1300 times, copper 250 to 2700 times, and zinc 3000 to 12,000 times. The corresponding figures for the benthonic organisms were: 700 to 16,000 times, 250 to 2700 times and 500 to 3800 times. Thus marine organisms participate actively in the biogeneic migration. (TTT)

24576 (A-AC-82/G/L-1243, pp 21-5) BUILDUP FACTORS OF MANGANESE, COPPER, AND ZINC BY CERTAIN HYDROBIONTS OF THE SEA OF AZOV. Rozhanskaya, L. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). (In Russian).

The buildup factor which indicates the ability to accumulate a given chemical element by marine hydrobionts, is expressed by the ratio of the element in the organism with respect to its concentration in the surrounding medium. This factor was determined for manganese, copper and zinc accumulated by different organisms collected at the same location. The heavy element content of the calcined samples was determined colorimetrically. The results indicated that phytoplankton concentrates manganese 200 to 1300 times, copper 250 to 1400 times and zinc 300 to 7000 times; the corresponding figures for zooplankton were 500, 2700, and 12,000; for benthonic organisms 700 to 16,000, 500 to 3000 and 500 to 3800 and for fish 30 to 400, 150 to 700 and 700 to 1800. The zooplankton also concentrates cobalt about 900 times. Earlier data by J. Mauchline on the concentration of cobalt by Mytilus and Cardium appear to be erroneous. (TTT)

24577 (A-AC-82/G/L-1254) RADIOECOLOGICAL PROCESSES OF ACCUMULATION AND DYNAMICS OF WATER MASSES IN SEAS AND OCEANS. Parchevskii, V. P.; Barinov, G. V.; Khanaichenko, N. K.; (and others) (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1968. 44p. (In Russian). Dep.

Separate abstracts were prepared for all five papers in this monograph. (E.R.B.)

For abstracts of individual papers see: 24578–24581, and 24711.

24578 (A-AC.82/G/L-1254, pp 3-9) ^{90}Sr IN CERTAIN ORGANISMS IN THE RED SEA AND THE GULF OF MEXICO. Parchevskii, V. P.; Sokolova, I. A.; Polikarpov, G. G.; Zaitsev, Yu. P.; Bachurin, A. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). (In Russian).

The geographical distribution of the concentration of ^{90}Sr was investigated, using a low-background instrument to measure the activity of the separated ^{90}Y preparations; the radiation was recorded under an angle of 2π with an efficiency of 25 to 34%. The stable Sr content was determined by means of a flame spectrometer. Algae, corals, molluscs, and echinoderms from the Red Sea and the Gulf of Mexico were used as specimens for determining the ^{90}Sr content. Comparison of the ^{90}Sr content of related species of sargassum and madrepore corals, calculated on the basis of the ash content, indicated that the concentration of this radionuclide is 1.5 to 2 times higher in the Gulf of Mexico than in the Red Sea. The highest concentration was found in the shells of molluscs and corals. The concentration of stable Ca and Sr in the water of the Gulf of Mexico were (0.425 ± 0.015) mg/ml and (8.3 ± 0.3) × 10^{-3} mg/ml, respectively. (TTT)

24579 (A-AC.82/G/L-1254, pp 10-12) STRONTIUM CONTENT OF PLANKTON IN THE PACIFIC AND ATLANTIC OCEANS. Barinov, G. V.; Romanov, V. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). (In Russian).

Some of the isotopes found in the oceans as a result of nuclear weapons testing are selectively concentrated by various organisms; among these nuclides, ^{90}Sr is especially dangerous because of its long half-life. The buildup factor of ^{90}Sr may be calculated from the data on the ^{90}Sr concentration in sea water collected in various parts of the Pacific and the Atlantic Oceans and the stable strontium content of plankton. The calculations were made on the basis of the ash content of the plankton specimens; the weight of the ash amounted to about 4% of the live weight. The buildup factor was determined as the ratio of Sr per live weight/water or ash/salt, using a Sr concentration in the sea water of 8×10^{-3} g/l and the salinity of 3.5%. The analyses indicated that the Sr concentration of zooplankton from various parts of the oceans is quite low; therefore, it was concluded that the oceanic zooplankton accumulates Sr only to a slight extent. In parts of the Pacific Ocean where the biomass of plankton is low, the biological factor does not play an important role in the surface and depthwise transfer of Sr. (TTT)

24580 (A-AC.82/G/L-1254, pp 13-17) ACCUMULATION OF NATURAL AND ARTIFICIAL RADIONUCLIDES IN THE OCEAN BY ALGAE AND PLANKTON. Barinov, G. V.; Blinov, M. V.; Gritchenko, Z. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). (In Russian).

During the 20th trip of the research ship "Mikhail Lomonosov," the radioactivity of zooplankton phytoplankton, sargassum and algae growing on the ship were measured in various regions in the Pacific and Atlantic Oceans. A radiometer and an NaI(Te) crystal γ spectrometer with a multichannel analyzer was used to determine the β and γ activities, respectively, of the ashes of the collected specimens. The results indicated that the sargassum-type algae concentrate ^{234}Th; the green algae overgrowth was found to have a buildup factor of $n \times 10^5$ for this isotope. This ability of the algae to concentrate selectively ^{234}Th may be used to develop an algologic method for determining the ^{234}Th concentration at the surface of the sea. Zooplankton collected around the Mururoa Atoll was found to contain considerable amounts of ^{95}Zr, ^{95}Nb, ^{103}Ru, ^{141}Ce, and ^{144}Ce. The zooplankton may be used as a biological indicator for the presence of these artificial radionuclides in the water. (TTT)

24581 (A-AC.82/G/L-1254, pp 24-44) DYNAMICS OF THE WATER MASSES IN THE TROPICAL REGIONS OF THE ATLANTIC OCEAN, ENRICHED IN ^{90}Sr AND ^{137}Cs. Khanaichenko, N. K. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). (In Russian).

As a result of underwater nuclear explosions, large amounts of radioactive materials were introduced directly into the ocean; other materials were introduced indirectly through the atmospheric fallout. Instead of a tendency toward uniform concentration as a result of mixing areas, surprisingly low and high concentrations of ^{90}Sr were discovered. This was due to special circulation of the sea water in ocean currents. The problem was studied on the basis of earlier data reported in the world literature including specifically the IAEA reports. The appearance of relatively high concentrations of ^{90}Sr in the tropical regions of the Atlantic Ocean in deep lying areas was attributed to the advective transfer of water from the convergence zone where while at the surface it received radioactive contamination from the atmosphere. At the Equator, the water rises from the depth and spreads out on the surface; 40 to 100 miles south and north from the Equator are the convergence zones where the water masses flow together and sink. The long-lived radionuclides penetrate toward the depths of oceans under the influence of such a turbulent exchange process at the low latitudes, reaching depths of only 300 to 400 m; in other areas they penetrate to 800 m. The radionuclides are carried away speedily from their origin to great distances. In view of the stable depth-wise distribution of the various characteristics of the water, it must be assumed that the ^{90}Sr and ^{137}Cs content is of advective origin. (TTT)

24582 (NP-17712) RADIOECOLOGICAL CONCENTRATION PROCESSES AND MASS WATER DYNAMICS IN SEAS AND OCEANS. Parchevskii, V. P.; Barinov, G. V.; Khanaichenko, N. K.; (and others) (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1968. 44p. (In Russian). Dep.

The highest ^{90}Sr concentration was found in the shells of mollusks and corals. The ^{90}Sr content in hydrobionts of the Gulf of Mexico were a factor of 1.5 to 2.0 higher than in plants of the Red Sea. The Ca and Sr concentrations in plants of the Gulf of Mexico are about 0.25 mg of Sr and ~10 mg of Ca per gram of dry weight of the plant. It was found that oceanic zooplankton in the Atlantic and Pacific accumulate Sr only slightly, and play only a small role in the transfer of Sr from the surface to the ocean deeps. Green algae were found to be a specific ^{234}Th concentrator with an accumulation coefficient of 10^5, and can be used to determine the ^{234}Th content in surface ocean waters. Zooplankton accumulate ^{95}Zr, ^{95}Nb, ^{103}Ru, ^{141}Ce, and ^{144}Ce, and serve as a biological indicator for these radionuclides. By studying the ^{90}Sr concentrations as a function of depth and width in large moving water masses it was found that ^{90}Sr penetrates the deeper ocean layers by advection at rates significantly greater than reported by other methods. Advection allows this mixing to take place much faster than would occur in the case of vertical exchange by turbulent diffusion. (TTT)

24583 (SWRHL-55-r) PROGRESS REPORT FOR THE BIO-ENVIRONMENTAL RESEARCH, MAY 22, 1964-JULY 1, 1966. PART I. EXPERIMENTAL DAIRY HERD. Smith, Donald D.; Engel, Ronald E. (Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab.). Mar. 1969. 106p. Dep. CFSTI.

Environmental surveys were made at stations where there was a reasonable probability that radioactivity would be released to the atmosphere from nuclear tests. Dairy-cow facilities, dairy-cow husbandry, veterinary medicine, and experiments using dairy cows are described. Following the reactor tests, Tory II-C and Kiwi, amounts of radioiodine entering cow's milk from inhalation and ingestion of fallout were measured under simulated summer-feeding conditions. Amounts of radioiodine deposited on alfalfa hay and on green forage were also determined. Following Project Sulky, a nuclear-cratering experiment for development of nuclear excavations, the amount of radioiodine entering cow's milk was measured under simulated winter-feeding conditions. The amount of radioiodine deposited on stack-baled and loose piled alfalfa hay was also measured. Following Project TNT, the maximum possible radioiodine uptake by dairy cows from typical winter dairy-farming practices was measured. Kinetics of uptake and secretion of radioiodines in milk following ingestion of contaminated hay were studied. Following Project Palanquin, determinations were made on the kinetics of secretion of radioiodine in the milk of cows fed contaminated hay or green forage in a controlled experiment, uptake of and secretion of radioiodine in the milk of cows maintained in a contaminated environment but not allowed to eat contaminated food, and kinetics of uptake and body distribution of radioiodine in calves drinking milk from cows involved in the ingestion experiment. Project Milkrun included development of analytical techniques for detection of ^{128}I in the presence of ^{131}I; determinations of variations with time of ^{128}I and ^{131}I levels in milk from cows given a single ingestion dose of these iodines mixed in various proportions; and determination of calf thyroid uptake from ingestion of milk obtained from these cows. Project Hayseed included determination of amounts of ^{131}I deposited per kg upon spread hay, spread green forage, and growing Sudan grass as a result of dissemination of ^{131}I in the form of a dry aerosol; kinetics of secretion of ^{131}I in milk of dairy cows fed different types of contaminated forage; and determination of uptake of ^{131}I and kinetics of secretion of ^{131}I in milk of cows maintained in a contaminated environment but not allowed to eat contaminated food. (H.L.W.)

24584 (TID-25006) ENVIRONMENTAL RADIOACTIVITY AT ARGONNE NATIONAL LABORATORY, JULY-DECEMBER 1968. Annual Summary, 1968. ([Argonne National Lab., Ill.]). 32p. Dep. CFSTI.

The radioactivity of the environment was determined by measuring the radioactivity in naturally occurring materials collected both on and off the Argonne site. Since radioactivity is usually spread by air and water, the environmental monitoring program concentrated on these materials. The total alpha and beta activities and the concentrations of several fission products and of ^{7}Be are summarized by means of a table. The alpha activities were caused by naturally occurring nuclides; the beta activity was caused by fission products from nuclear test detonations. The beta activity increased from January through April as the concentrations of several of the fission products, notably ^{95}Zr-^{95}Nb, increased. The beta activity then decreased gradually during the remainder of the year as the fission product activity declined. The similarity between alpha, beta, and fission product activities on and off the site indicated that Argonne did not add significantly to the particulate air-borne activity of the environment. Concentrations of ^{41}Ar and ^{3}H in air were measured in the 300 Area near the CP-5 reactor because these nuclides are produced continuously while the reactor is in operation. Sawmill Creek was sampled above and below the discharge to evaluate the effect of waste water from Argonne on the radioactivity in the creek. In addition to natural and fallout activity, radioactivity from waste water was found in samples of Sawmill Creek water collected below the discharge. A comparison of these concentrations with those above the discharge indicated that essentially all of the ^{137}Cs, ^{58}Co, ^{60}Co, ^{3}H, Pu, and ^{99}Tc and about one-half of the ^{90}Sr, U, ^{234}Th-^{234}Pa, and total alpha and beta activities originated in Argonne waste water. The concentrations were all small compared to radiation protection standards. Raw milk produced in the area was analyzed monthly for several fission products. The long-lived fission products, ^{137}Cs and ^{90}Sr, were present in all samples. The concentrations of radioactive substances added to the environment during the year by Argonne were considerably less than the radiation protection standards and did not constitute a health hazard. (H.L.W.)

24585 COEFFICIENTS OF ACCUMULATION OF STRONTIUM AND ^{90}Sr IN LAKE PLANTS AND PLANKTON. Kaliniya, Z. K.; Osipenko, S. A. (Inst. of Biology, Riga. Inst. of Biology, Sevastopol, USSR). Radiobiologiya, 9: No. 1, 111-12(1969). (In Russian).

The coefficients of accumulation of stable and radioactive strontium by eight species of lake macrophytes and plankton were determined. The coefficients of accumulation of stable strontium and strontium-90 in plankton are of the order of tens of units. From the data obtained it follows that strontium-90 exists in equilibrium with natural strontium in lake solutions. (JPRS)

24586 RADIOECOLOGICAL INVESTIGATIONS IN THE REGION OF MURUROA ATOLL (TUAMOTU ISLAND). Kolesnikova, A. N.; Barinov, G. V.; Zesenko, A. Ya. (Inst. of Biology, Sevastopol, USSR). Radiobiologiya, 9: No. 1, 139-43(1969). (In Russian).

The article presents materials from the 20th voyage of the scientific research ship Mikhail Lomonosov, the route of which passed through sites of former and present-day atomic firing ranges. The γ spectra of samples of zooplankton, in which the isotopes cerium-141 and 144, zirconium-95, niobium-95, and ruthenium-103 were detected in concentrations from 0.16 to 12 pCi per kg of live weight, were taken. In the region of Mururoa Atoll, the French atomic firing range, anomalous crayfish from the genus Pleuromamma were detected. The number of anomalous crayfish is directly dependent on the radioactivity of the plankton. (JPRS)

24587 COEFFICIENTS OF ACCUMULATION OF ^{90}Sr IN CERTAIN FISH (RADIOECOLOGICAL INVESTIGATION). Dushauskene-Duzh, N. F.; Polikarpov, G. G.; Styro, B. I. (Inst. of Physics and Mathematics, Vilnyus, USSR. Inst. of Biology, Sevastopol, USSR. Radiobiologiya, 9: No. 1, 113-15(1969). (In Russian).

A procedure for the isolation of strontium-90 and lead-210 from hydrobionts is described. The coefficients of accumulation of strontium-90 for lake fish are cited and compared with the coefficients of accumulation in mollusks and water plants. The correlation of the strontium-90 and lead-210 coefficients is depicted graphically. The distribution of strontium-90 among the organs and tissues of fish is cited. (JPRS)

24588 ON A RELATION OF THE COEFFICIENT OF ACCUMULATION OF RADIOISOTOPES IN AQUATIC ORGANISMS WITH THE POSITION OF THE ELEMENT IN THE PERIODIC SYSTEM OF MENDELEEV. Chugunov, V. V. Gidrobiol. Zh., Akad. Nauk Ukr. SSR, 4: No. 5, 58-62(1968). (In Russian).

An attempt to establish in a general way a relation between the size of accumulation coefficients and the positions of elements in the periodic table resulted in finding a dependence of semiquantitative character. If experimental data for a given type of algae (i.e., the accumulation coefficient for isotopes of each element) are used a graph may be constructed for use in the region of 10^{-11} to 10^{-8} mole/liter for aqueous concentrations of elements. Relations between the radius of ions and their accumulation coefficients in freshwater algae in respect to potentials of ionic atmospheres are plotted. Correlations between coefficients and the ionic radius of elements of the fourth and fifth periods are plotted. (BBB)

Genetics and Cytogenetics

Refer also to abstracts 24500 and 24768.

24589 EXPRESSIVITY OF THE FORKED MUTATION OF DROSOPHILA MELANOGASTER UNDER THE ACTION OF X RAYS AT VARIOUS STAGES OF ONTOGENESIS. Svetlov, P. G.; Korsakov, G. F. (Inst. of Cytology, Leningrad). Radiobiologiya, 9: No. 1, 155-8(1969). (In Russian).

The irradiation of larvae in the prepupal stage at a dose of 50 R lowers the number of anomalous bristles among the flies developing from them, while irradiation at a dose of 600 R substantially increases it. The influence of the latter dose on the early phases of ontogenesis, on the embryos in fresh-laid eggs, and on the larvae in the prepupal instar gives a sharp increase in the expressivity of the marker trait (number of anomalous macrochaetae). At the remaining points of the individual cycle, this dose has practically no effect on the expressivity of the mutation or even somewhat reduces it (after irradiation of two-day larvae). A comparison of the variation of radiosensitivity and thermosensitivity in the ontogenesis of forked mutants reveals an exact coincidence of the three peaks of the curves corresponding to the three critical periods of development of the macrochaetae. The changes in the expressivity of the investigated mutation, obtained by irradiation, in contrast to temperature changes, are not transmitted by heredity. (JPRS)

24590 INFLUENCE OF ANOXIA USED AT VARIOUS TIMES ON THE YIELD OF CHROMOSOME ABERRATIONS INDUCED BY γ RAYS. Luchnik, N. V.; Yakovenko, K. N. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 9: No, 1, 62-8(1969). (In Russian).

In the work data were obtained indicating that anoxia, used after irradiation, quite reliably lowers the yield of chromosome aberrations. An analysis of the data obtained shows that anoxia promotes postradiation recovery. The joint application of anoxia at different periods (before, during, and after irradiation) gives not a simple summation of the individual effects, but the observed effect may be either higher or lower than that expected. A different influence of anoxia on different types of chromosome mutations was established. (JPRS)

24591 DNA REPAIR. Howard-Flanders, Paul (Yale Univ., New Haven). Annu. Rev. Biochem., 37: 175-200(1968).

A review is presented on DNA repair mechanisms in Escherichia coli and the bacteriophages T4 and λ. The role of DNA in promoting survival after genetic damage, recombination, and replication is emphasized. The first section is concerned with the principal types of structural damage induced in DNA by chemical mutagens and radiations. The next section examines the mechanisms for repair of damaged DNA, starting from the initial interruption of one strand at a structural defect, and proceeding to the reconstruction of the intact covalently bound twin helix. The following section deals with the replication of DNA containing damaged bases, and the subsequent reconstruction from newly synthesized material, of the functional chromosomes required for survival of colony forming ability. The final section reviews the DNA nucleases, polymerase and ligase, and their possible functions. A list of 160 references is included. (H.L.W.)

24592 CHANGES IN THE ULTRAVIOLET SENSITIVITY OF ESCHERICHIA COLI DURING GROWTH IN BATCH CULTURES. Morton, R. A.; Haynes, R. H. (Univ. of California, Santa Barbara. York Univ., Toronto). J. Bacteriol., 97: 1379-85(Mar. 1969).

The ultraviolet (uv) sensitivity of Escherichia coli B/r harvested at various times during growth in batch cultures was measured. The results showed a period of increased uv sensitivity in late log phase, just before the cultures entered stationary phase. This increase in sensitivity was associated with a decreased shoulder in the uv survival curves. The postirradiation division delay of survivors was shortest for cells harvested during the period of maximal sensitivity. This period of increased uv sensitivity during late log phase was not found in the radiation-sensitive, repair-deficient mutant B_{s-1} (a strain which is unable to excise pyrimidine dimers from uv-damaged deoxyribonucleic acid). These results suggest that the variation in uv sensitivity of E. coli B/r as a function of time of harvesting of the cells from batch cultures is related to the varying capacities of these populations to repair uv-damaged deoxyribonucleic acid. Further experiments designed to elucidate the mechanism underlying this variation in uv sensitivity indicated that it arises from the partial depletion of nutrients in the medium during late log phase. We suggest that growth in such depleted media leads to a depression in the intercellular concentration or activity of one or more of the repair enzymes concerned with the repair of damaged deoxyribonucleic acid. (auth)

24593 MUTANT OF ESCHERICHIA COLI WITH ANOMALOUS CELL DIVISION AND ABILITY TO DECREASE EPISOMALLY AND CHROMOSOMALLY MEDIATED RESISTANCE TO AMPICILLIN AND SEVERAL OTHER ANTIBIOTICS. Normark, Staffan; Boman, Hans G.; Matsson, Eva (Univ. of Umea, Sweden). J. Bacteriol., 97: 1334-42(Mar. 1969).

In a mutation experiment with a rough, ampicillin-resistant strain, we isolated two smooth mutants which were both sensitive to ampicillin and carried defects in the cell envelope. One of the strains (with the envA gene) is hindered in its completion of septa and forms chains of cells. The envA gene has been mapped to a position between leu and proB, at 2 to 4 min. The envA gene decreased the resistance mediated by both episomal and chromosomal genes for resistance to several antibiotics. During growth the envA mutant was characterized by abnormal ratios between viable count or cell count and optical density. The ratio between viable count and optical density was affected during shift-up and shift-down experiments. When compared to the parent strain, the envA mutant was found to be more resistant to ultraviolet irradiation on plates. Prestarvation for tryptophan had a protective effect against irradiation both on the parent strain and the envA mutant. (auth)

24594 SOME PROPERTIES OF EXCISION-DEFECTIVE RECOMBINATION-DEFICIENT MUTANTS OF ESCHERICHIA COLI K-12. Howard-Flanders, Paul; Theriot, Lee; Stedeford, J. Brian (Yale Univ., New Haven). J. Bacteriol., 97: 1134-41(Mar. 1969).

Strains of Escherichia coli that carry the mutation uvrA6 show no measurable excision of pyrimidine dimers and are easily killed by ultraviolet (uv) light, whereas strains that carry recA13 are defective in genetic recombination and are also uv-sensitive. An Hfr strain carrying uvrA6 was crossed with an F^- strain carrying recA13. Among the recombinants identified, one carrying uvrA recA proved to be of exceptional sensitivity to uv light. It is estimated from the uv dose (0.2 erg/mm^2 at 253.7 nm) required to reduce the number of colony-forming cells by one natural logarithm that about 1.3 pyrimidine dimers were formed in a genome of 5×10^6 base pairs for each lethal event. This double mutant is 40 times more uv-sensitive than the excision-defective strain carrying uvrA6. The replication of one pyrimidine dimer is generally a lethal event in strains carrying recA13. Spontaneous breakdown and uv-induced breakdown of the deoxyribonucleic acid (DNA) of cells of the various genotypes were estimated by growing the cells in medium containing ^3H-thymidine and measuring both

acid-precipitable and acid-soluble radioactivity. The uv-induced degradation in strains with recA13 did not require the uvr^+ genes and hence appears to depend upon a mechanism other than dimer excision. The greater level of survival after irradiation in Rec^+ as compared to Rec^- bacteria may be caused by a recovery mechanism involving the reconstruction of the bacterial chromosome through genetic exchanges which occur between the newly replicated sister duplexes and which effectively circumvent the damaged bases remaining in the DNA. (auth)

24595 REPLICATION OF THE BACTERIAL CHROMOSOME: LOCATION OF NEW INITIATION SITES AFTER IRRADIATION. Billen, Daniel (Univ. of Florida, Gainesville). J. Bacteriol., 97: 1169-75(Mar. 1969).

New loci of replication along the bacterial chromosome are observed after irradiation of Escherichia coli. It was conjectured that, after x-irradiation, the new initiation site was random with respect to the fixed-origin, whereas, after ultraviolet light exposure, it was selective and appeared to be from the fixed-origin. Evidence presented here shows that, after x-irradiation of E. coli, the new initiation site(s) for the onset of deoxyribonucleic acid replication is induced at chromosomal regions not restricted to the fixed-origin. After ultraviolet light exposure, the new initiation site is preferentially from the fixed-origin. In these studies amino acid starvation was used to synchronize chromosome replication and to allow for differential radioisotopic labeling of the chromosomal origin and terminus. To facilitate interpretation, growing cells actively replicating their chromosomes were compared with cells lacking growth points at the time of irradiation. The role of these new replication sites in the observed kinetics of deoxyribonucleic acid replication following x-ray or ultraviolet light exposure is discussed. (auth)

24596 DARK RECOVERY PROCESSES IN ESCHERICHIA COLI IRRADIATED WITH ULTRAVIOLET LIGHT. II. EFFECT OF UVR GENES ON LIQUID HOLDING RECOVERY. Ganesan, Ann K.; Smith, Kendric C. (Stanford Univ., Calif.). J. Bacteriol., 97: 1129-33(Mar. 1969).

The uvr mutations of Escherichia coli K-12 decrease the ability of cells to survive ultraviolet light (uv), to excise pyrimidine dimers from their deoxyribonucleic acid and to reactivate bacteriophage exposed to uv. The rec mutations decrease the ability of the cells to survive uv and to undergo genetic recombination. Certain rec mutations, including recA1, rec-12, recA13, and rec-56, are necessary for the expression of liquid-holding recovery (LHR), observed as an increase in colony-forming ability when irradiated cells are held in buffer in the dark. These rec mutations appear to act indirectly to permit the detection of LHR rather than to affect its occurrence directly. We have tested the effect of uvr markers on LHR in cells containing one of these rec mutations. Recombinants containing rec-56 together with a uvr marker were constructed and tested for LHR. None of the 39 recombinants examined, carrying uvrA6, uvrB5, or uvrC34, showed LHR. Three rec^- uvr^- strains were also tested for photoreactivation. In all three, photoreactivation was observed, indicating that they contained detectable amounts of pyrimidine dimers. Our results are consistent with the idea that uvr mutations inactivate LHR, and suggest that LHR reflects excision-dependent repair of pyrimidine dimers. (auth)

24597 INFLUENCE OF MASS SELECTION AND THERMAL NEUTRON IRRADIATION ON MEANS AND CUMULATIVE GENE EFFECTS IN A VARIETY OF CORN (ZEA MAYS L.). Hornbrook, Albert Ray. Lincoln, Nebr., Univ. of Nebraska, 1968. 120p.

Thesis.

Eight cycles of mass selection for grain yield have increased yield approximately twenty-nine percent in both control and thermal neutron irradiated samples of the Hays Golden Variety of corn. In order to investigate changes in means and cumulative gene effects, 126 populations were derived from Hays Golden and some of the selected generations by crossing, selfing, random mating or some combination of these operations. Five quantitative traits studied were grain yield, number of ears per plant, days to flower, ear height and plant height. The model used to estimate the cumulative gene effects was described by Gardner and Eberhart in 1966. Parameters, which were defined as functions of the gene frequencies and additive and dominance effects for individual loci, provide estimates of heterosis effects and the contributions of homozygous loci and heterozygous loci. Variations due to deviations from the model by Gardner and Eberhart indicate the existence of epistasis and/or linkage. Since only a limited amount of previous data has been analyzed as outlined by the model, the practical application of the model was evaluated. If the assumptions underlying the model are fulfilled, the contributions of homozygous loci would be expected to increase with selection and the contributions of heterozygous lock would apparently remain relatively stable or decrease. The anticipated results were obtained in the selected control populations for all traits except grain yield. The thermal neutron treatments did disturb the gene effects in the irradiated sample, but response after selection was also as expected for all traits except yield. Questionable estimates of cumulative gene effects were obtained for grain yield. Although the contributions of homozygous loci appeared to be recovering as anticipated after treatment in the irradiated sample, the contributions of homozygous loci for the control sample were erratic. Both the control and irradiated samples showed increases in the contributions of heterozygous loci for grain yield as mass selection advanced. Several alternatives are discussed as possible explanations for the surprising behavior of the cumulative gene effects for yield. The actual cause(s) could not be resolved in this thesis study, but some of the more likely explanations are low gene frequencies in Hays Golden, disequilibrium due to selection, improper experimental design, or defects in the model itself. Although the validity of some parameter estimates may be doubtful, the parameters estimated from the model were more accurate than observed values in predicting population performance in different environments. The defined heterosis effects accounted for very little of the total variation among population means for all traits except ear number. Variations due to deviations from the model were small, except for ear number, but were significant at the 0.05 level of probability. (Diss. Abstr.)

24598 STUDIES ON THE CONTAMINATION AND THE VARIATION OF CROP PLANTS CAUSED BY RADIOACTIVITY. V. CHLOROPHYLL VARIANTS AND HETEROSIS IN PROGENIES OF γ-RAYED RICE AND BARLEY. Katayama, Yoshio; Shida, Shojiro (Miyazaki Univ., Japan). Miyazaki Daigaku Nogakubu Kenkyu Jiho, 15: 75-9(Sept. 1968). (In Japanese).

With a view to investigating possible occurrence of one-gene heterosis, some harvesting characters of heterozygous and dominant homozygous breeds of chlorophyll variants in progenies of γ-irradiated rice and barley were compared. Regarding chlorophyll mutant genes, heterosis was not ascertained in most of the materials of rice and barley. If one-gene or two-gene heterosis is ascertained in autogamous plants, heterosis breeding is possibly attained by seed production from the heterozygous plants or by utilizing balanced lethal genes. (NSA of Japan) (TSS)

24599 NATURE OF INDUCED MUTATIONS IN HIGHER PLANTS. Nilan, R. A. (Washington State Univ., Pullman). Contract AT-(45-1)-353. Abh. Deut. Akad. Wiss. Berlin Kl. Med., 1967 No. 2, 5-20(1967).

Information on the nature of induced mutations in higher plants is appraised. Data are reviewed on: pleiotropism and recessiveness of induced mutations; comparison of induced and spontaneous mutations in terms of their extragenic or intragenic nature; types of extragenic mutations, single locus mutations; intragenic, events during mutagenesis, control of mutation spectra and specificities; and comparative effects of various radiations and chemical agents. 122 references. (M.M.B.)

24600 NEW TYPES OF RESPIRATORY DEFICIENT MUTANTS IN SACCHAROMYCES CEREVISIAE. II. PHYSIOLOGY AND GENETICS OF A SERIES OF SEGREGATIONAL MUTANTS INDUCED BY ULTRAVIOLET IRRADIATION OR NITROUS ACID TREATMENT. Lachowicz, Tadeusz Michal; Kotylak, Zbigniew; Kolodynski, Jan; Sniegocka, Zdzislawa (Univ. of Wroclaw). Arch. Immunol. Ther. Exp., 17: 72-85(1969).

Seven segregational mutants deficient in cytochromes $a + a_3$ and b and five mutants deficient in cytochrome $a + a_3$ have been isolated. Only two were found allelic with the mutants known until now. Tests for allelism permitted distinction of five new genes responsible for the phenotype deficient in cytochromes $a + a_3$ and b and four new genes that mutation results in deficiency in cytochrome $a + a_3$ only. In addition, some new types of mutants have been identified; mutants deficient in cytochrome b only, and a mutant with conditional deficiency of cytochrome c_1 and probably c. Other mutants were those with inefficient respiration more or less strongly expressed. Two of them were found allelic, confirming 0.4 pattern of segregation. One of the mutants showed inhibited respiration in spite of normal cytochrome spectrum. (auth)

24601 REPAIR OF RADIATION-INDUCED DAMAGE TO CHROMOSOMES: INDEPENDENCE OF KNOWN DNA DARK REPAIR MECHANISMS. Wolff, Sheldon; Scott, D. (Univ. of California Medical Center, San Francisco). Exp. Cell Res., 55: 9-16(Apr. 1969).

Chromosomes contain large amounts of protein in addition to DNA and often appear to be multistranded. Despite this it has been proposed that the repair (restitution) of radiation-induced chromosome breaks and the rejoining that leads to the formation of ex-

changes takes place by the same processes involved in dark repair of DNA, i.e., it has been suggested that there is base pairing of portions of single DNA strands from double helices and resynthesis using the opposite strand as a template. Experiments with Vicia faba root tip cells, Chinese hamster cells of B14FAF and DON lines in tissue culture, and human leukocytes from normal persons as well as patients with Xeroderma pigmentosum show that x-ray induced breaks can rejoin in all of these systems. Since Vicia, B14FAF Chinese hamster cells, and Xeroderma cells do not exhibit unscheduled DNA synthesis (presumably dark repair) the experiments are interpreted to indicate that the repair of chromosomal damage and the formation of exchanges do not occur by dark repair of DNA. This interpretation is strengthened by x-ray dose fractionation studies in Vicia in which it was found that caffeine (which inhibits dark repair in bacteria) does not effect the joining of chromosome breaks. The repair of uv-induced chromosome breaks also seems to be independent of DNA dark repair mechanisms. (auth)

24602 CYTOGENETICAL STUDIES ON SOME X-RAYS AND ^{32}P INDUCED MUTANTS OF RICE. Majumder, B. (Bose Inst., Calcutta). J. Indian Bot. Soc., 45: 257-65(Mar. 1967).

Two mutants namely "Black Mutant" (Selection No. S. I) and "Marichbati-awned" (Selection No. S. 236) were isolated from the Marichbati var. of Aus paddy following ^{32}P irradiation. Another mutant "White Dular" (Selection No. S. 240) was induced in the var. Dular following 50 KR x-ray treatment. These three mutants were compared with parent lines in the yr. 1961 and again in 1962 with their parent lines as well as other local var. The "Black Mutant" (S.I) was found to produce higher number of tillers and panicles, as well as yield per plant when compared to its parent. However this mutant was later in flowering and had weaker straw. Variation in agronomic characters between the "Marichbati-awned" (S. 236) and its parent was not very pronounced. The third mutant "White Dular" (S. 240) had lower yield but exhibited more straw stiffness when compared to its parent. The cytological studies of these mutants did not reveal many irregularities. Reciprocal crosses were made between Black Mutant (S.I) and its parent Marichbati var. and segregation for leaf-sheath character was noted in the F_2 generation. Purple and green pigments of leaf-sheath were found to segregate in the ratio 3:1, purple being dominant. (Indian Sci. Abstr.)

24603 COMPARISON OF THE EFFECT OF X RAYS (SOFT X RAYS) ON THE PRODUCTION OF MUTATION IN DIPLOID AND TETRAPLOID SPECIES OF PHALARIS. Prasad, Akhouri Balarm (Univ. of Bihar, India). Cytologia (Tokyo), 32: 444-9 (Dec. 1968).

Dry dormant seeds of Phalaris canariensis Linn. (2n = 12) and Phalaris minor Retz. (2n = 28) were irradiated with 10 Kr. soft x rays at the M.R.C. Unit, Hammersmith Hospital, London and its effects on the production of chlorophyll, and morphological mutants at M_2 generation were studied and discussed in both the species. In Phalaris canariensis Linn., the usual chlorophyll mutants, virescens, chlorina, lutescens, albino, tigrina, virido-albino, and maculata were seen at seedling stage. Viridis was found to be most common and maculata most rare. When viridis was broken up into different types on the basis of colouration, lutescens was more common than virescens and chlorina which were present in almost equal numbers. The frequency of mutants varies from 0.22 to 4.5. This was determined per 100 M_2 seedlings and was found to be higher at the low fertility range. No mutants were seen between the 71 and 90% fertility classes. Morphological mutants of the type, split and appendage on the margin of the leaf, split on the margin and lamina, appendage on the margin, trifid and bifid apex, rudimentary leaf, leafless, twisted and pendulate rachis and whitehead, tweaky, multiflorous, impeded, and white-green and spikeless inflorescence were observed in P. canariensis. No chlorophyll and morphological mutants were seen in P. minor in the 19,708 seedlings tested. The appearance of chlorophyll and morphological mutants at M_2 generation in the diploid species P. canariensis (2n = 12) suggested that they were more sensitive to radiation than the tetraploid P. minor (2n = 28). (NSA of Japan)

Health Physics and Safety

Refer also to abstracts 24321, 24438, 24450, 24451, 24469, 24473, 24489, 24499, 24501, 24505, 24507, 24533–24536, 24538–24550, 24573–24576, 24583, 24584, 24586, 24758, 25728, 25737, 25742, and 25743.

24604 (A-AC-82/G/L-1243, pp 3-5) BUILDUP FACTOR OF ^{90}Sr IN VARIOUS TYPES OF RESERVOIRS. Kalninya, Z. K.; Polikarpov, G. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). (In Russian).

The buildup factors of ^{90}Sr in the planktons of eutrophic, mesotrophno-eutrophic and dystrophic basins were determined by analyzing the ashes of planktons. The decay of the ^{90}Y separated during the water and plankton analyses was found to follow in every case the theoretical decay curve of this nuclide. The results indicated that the buildup factor of the plankton in dystrophic lakes is affected by the low calcium content of the water which ranges from 4 to 6 mg/l and possibly by the presence of specific component, such as phytoplankton and sapropel. The calcium content of the other two types of lakes was much higher, ranging from 35 to 41 mg/l, while their stable strontium content amounted to about 70 μg/l. Thus, the plankton from dystrophic lakes possesses a very large capacity per unit mass for ^{90}Sr in comparison with the other two types. (TTT)

24605 (AHSB(RP)R-78(3rd Ed.)) THE APPLICATION AND INTERPRETATION OF ICRP RECOMMENDATIONS IN THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY (JUNE 1967). Dunster, H. J. (United Kingdom Atomic Energy Authority, Harwell (England). Authority Health and Safety Branch). Oct. 1968. 20p. Dep. CFSTI. UK 3s. 6d.

This report summarizes the Maximum Permissible Doses (MPD) and dose-limits recommendations of the ICRP as interpreted and adopted by the United Kingdom Atomic Energy Authority. The summary is presented in two parts, the numerical values recommended for application in the Authority and the application of the recommendations. The MPD and Dose Limits are derived for internal and external exposure of working personnel and for members of the public. The report also includes a section on the management of working personnel exposed in excess of the recommended Dose Limits. (E.R.B.)

24606 (AHSB(RP)R-87) DOSE-RATE DISTRIBUTIONS FROM SPHERICAL AND SPHERICAL-SHELL RADIATION SOURCES, WITH SPECIAL REFERENCE TO FISH EGGS IN RADIOACTIVE MEDIA. Adams, N. (United Kingdom Atomic Energy Authority, Harwell (England). Authority Health and Safety Branch). Oct. 1968. 19p. Dep. CFSTI. UK 3s. 6d.

Dose-rate distributions are estimated theoretically for two point-source dose-functions: inverse square law, which is appropriate for gamma radiation and for hard beta radiation if the sphere radius is small; and Loevinger's function, which is more generally applicable for beta-radiation. Three distributions of activity are considered, namely: uniform within the sphere, uniform in the medium surrounding the sphere, and uniform in a layer at the surface of the sphere. The effects of aggregations of sources are discussed. Examples are given to illustrate the application of the derived formulae to fish eggs immersed in water containing radioactivity. In this circumstance some nuclides are adsorbed principally on the surface of the egg, but other nuclides are absorbed essentially uniformly within the eggs. (auth)(UK)

24607 (CONF-670649-2) TECHNICAL AND LEGAL PROBLEMS AND INSURANCE AGAINST THE RISKS IN THE USE OF RADIOELEMENTS APPLIED TO ENGINEERING AND INDUSTRY. Cosin Alvarez, Carlos (Bureau Veritas, Madrid (Spain). Seccion de Control No Destructivo). [1966]. 13p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

Technical and legal protection problems and insurance are examined solely with respect to the use of industrial gammagraphy. The technique of industrial gammagraphy is given and the radioactive dangers in the use of radioisotopes are described. The protection standards are given. Three categories of insurance are outlined: incendiary, civil responsibility, and individual. (tr-auth)

24608 (COO-1500-9) RESPIRATORY PROTECTION FOR URANIUM MINERS. Martz, Dowell E. (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). June 1, 1968. Contract AT(11-1)-1500. 171p. Dep. CFSTI.

A method of analyzing filter samples by α spectroscopy was developed for accurately determining the airborne concentrations of RaA, RaB, and RaC in atmospheres contaminated with radon. The method was used to determine the concentration of radon daughter products in a uranium mine atmosphere and to evaluate respiratory protective devices worn by miners. Measurements of the radon daughter activity deposited in the respiratory tract of persons exposed to a representative mine atmosphere indicated average percent depositions of 50.7%, 43.9%, and 41.4% for the RaA, RaB, and RaC components. The fraction of the activity deposited depended on the properties of the aerosol inhaled and on the breathing pattern of the subject. Increased deposition was observed for large tidal volumes and low breathing rates. Several commercial and experimental respirator filters were tested for their ability to remove the radon daughter activity encountered in a mine atmosphere. High removal efficiencies were exhibited by densely packed fiber filters and by resin-impregnated wool filters.

An in vivo counting system capable of detecting the RaC activity present in the respiratory tract of working miners was used to estimate the protection afforded by respirators under mining conditions. Protection factors of five to 10 were achieved by several commercial respirators. (auth)

24609 (EUR-4244) STUDIES ON THE RADIOACTIVE CONTAMINATION OF THE SEA. Annual Report, 1967. Bernhard, M. (Comitato Nazionale per l'Energia Nucleare, La Spezia (Italy). Laboratorio per lo Studio Della Contaminazione Radioattiva del Mare). Jan. 27, 1969. 66p. (RT/BIO-(68)60). Dep.

The Fifth Annual Report of the CNEN-EURATOM Contract of Association is presented. The program laid down in this contract calls for studies of the factors which influence the uptake, accumulation and loss of radioisotopes by marine organisms. The program is divided into two parts: a survey of environmental elements and factors in a sampling area, and experiments on the influence of environmental factors on the uptake, accumulation and loss of radioisotopes by marine organisms in relation to the data obtained in the survey. The task of carrying out this program has been divided between six groups: chemistry, botany, zooplankton, microbiology, fisheries, biology and special developments. An account is given of the results obtained by these groups in 1967. (auth)

24610 (FMB-67-4-A) EVALUATION OF THE INFINITE DOSE AND THE TIME AFTER WHICH ONE CAN LEAVE THE SHELTER. Pretre, S. (Forschungsinstitut fuer Militaerische Bautechnik, Zurich (Switzerland)). Sept. 1967. 15p. (In French). Dep.

Catastrophic radioactive contamination caused by a large scale nuclear explosion is considered when the place of bursting is on the ground. A criterion is given for determining the time when it is possible to leave the shelter. A new formula is proposed for calculating the infinite dose one absorbs from the time he leaves the shelter for the next two or three years. It is estimated that the principal quality of a shelter is that it should be inhabitable for about one month. (tr-auth)

24611 (HASL-207) FALLOUT PROGRAM. Quarterly Summary Report, December 1, 1968-March 1, 1969. Hardy, Edward P. Jr.; Rivera, Joseph (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Apr. 1, 1969. 100p. Dep. CFSTI.

Current data are presented from the Health and Safety Laboratory Fallout Program, the National Radiation Laboratory in New Zealand, the EURATOM Joint Nuclear Research Center at Ispra, Italy, and the Radiological Physics Division at Argonne National Laboratory. The initial section consists of interpretive reports and notes covering the following topics: radium-226 in diet, strontium-90 and lead-210 in the upper stratosphere, plutonium-238 fallout from SNAP-9A, the global strontium-90 budget, strontium-90 in diet during 1968 and projected levels for 1969, and predicting strontium-90 concentrations in human vertebrae. Subsequent sections include tabulations of radionuclide levels in stratospheric air, surface air, fallout, milk, other diet components, and tap water. A bibliography of recent publications related to radionuclide studies is also presented. (auth)

24612 (HASL-207(App.)) APPENDIX TO FALLOUT PROGRAM QUARTERLY SUMMARY REPORT, DECEMBER 1, 1968-MARCH 1, 1969. (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Apr. 1, 1969. 366p. Dep. CFSTI.

Included in this appendix are reports on the following fallout monitoring programs: data on the monthly deposition of ^{89}Sr and ^{90}Sr at world land sites during 1954 to 1968. The data represent monthly samples from 36 monitoring sites in the United States and 103 sites in other countries; data on the ^{90}Sr deposition at four Atlantic Ocean weather stations during 1963 to 1968. The stations are maintained by the coast guard for continuous weather observations, and are sampled for ^{90}Sr deposition at approximately 21 day intervals; radionuclide content of monthly surface air samples during 1963 to 1968. Samples are collected from world wide land and marine sites and submitted to contractor laboratories for radiochemical analyses; the ^{90}Sr content of liquid and powdered whole milk in New York State. Data are reported on monthly samples during 1954 to 1968; and the ^{90}Sr content of tap water in New York City during 1954 to 1968. The ^{90}Sr to ^{137}Cs ratio in tap water is reported for the period during 1965 to 1968. (E.R.B.)

24613 (JPRS-46935) TRANSLATIONS ON EASTERN EUROPE SCIENTIFIC AFFAIRS NO. 24. Translated from Acta Vet. (Belgrade), No. 3, 119-26; 141-6(1968). 16p. CFSTI.

English translations are presented of two papers. A separate abstract was prepared for one paper; the remaining paper discussed epizootiology of foot-and-mouth disease. (H.L.W.)

For an abstract of the individual paper see: 24614.

24614 (JPRS-46935 (pp 2-7)) PERCUTANEOUS RADIOCONTAMINATION OF POULTRY. Begovic, Jevrosima; Zagorcic, Anica; Gligorijevic, J.; Draganovic, B.; Pavlovic, M. Translated from Acta Vet. (Belgrade), No. 3, 141-6(1968). CFSTI.

A mixture of ^{85}Sr and ^{89}Sr was applied to the feathers of the neck, back, chest, and legs of chickens. The contaminant was fixed by spontaneous drying at room temperature. Radiometric measurements were made with a Geiger-Mueller counter and autohistoradiographic records were made of percutaneous and transcutaneous penetration. Results indicated that the degree of contamination could only be explained in terms of the quantity and quality of the feathers in the various regions of the body. The level of contamination of the epidermis was 1.4% in the neck area, 1.1% in the back area, and 0.2% in the chest area. It was concluded that the feather covering is a substantial barrier to internal contamination in poultry. (H.L.W.)

24615 (PHS-999-RH-35) REGULATIONS, STANDARDS, AND GUIDES FOR MICROWAVES, ULTRAVIOLET RADIATION, AND RADIATION FROM LASERS AND TELEVISION RECEIVERS: AN ANNOTATED BIBLIOGRAPHY. Setter, Lloyd R.; Snavely, David R.; Solem, Duane L.; Van Wye, Rodman F. (Bureau of Radiological Health, Rockville, Md.). Apr. 1969. 77p. Public Health Service, Rockville, Md. Free.

An annotated bibliography of guidelines, standards, and regulations pertaining to public health protection against electromagnetic radiation from television receivers, lasers, ultraviolet radiation, and microwaves is presented. Each category of radiation is treated in a separate section. Since the terminology for regulations, standards, and guides is not uniform among Federal, State governments, municipal governments, military organizations, and nongovernmental organizations, the annotated documents are designated as Class A (established or adopted by a governmental body acting under the authority of an act, law, or statute), Class B (adopted by consensus of a committee(s) or commission(s) of technical competence in standards-setting organizations), or Class C (not adopted by a standards-setting organization, but contains information pertinent to the preparation of suitable standards or regulations). The annotations include identification of the document, type of standard, intended complier, intended benefitter, limits and specifications, and general guidance. (auth)

24616 (RT/PROT-(68)18) A CASE OF INTERNAL CONTAMINATION WITH ^{210}Po. Strambi, E.; Testa, C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 31p. (In Italian). (CONF-680535-2). Dep.

From 14th National Conference of the Italian Association for Health Physics and Protection from Radiation, Formia, Italy.

A case of internal contamination from ^{210}Po, caused probably by ingestion of polonium nitrate, is reported. The person was followed by monitoring of the hands and by determining weekly ^{210}Po in the urine for a period of three months after the contamination. The urine samples were mineralized with nitric acid, before spontaneous deposition of Po on silver, in order to obtain a more quantitative and reproducible chemical yield; the presence of ^{210}Po in the urine was also confirmed by alpha spectrometry. From the urinary excretion of ^{210}Po, a biological half-life of 29 days, was found which corresponds to a daily urinary excretion of 0.24% of the prevailing body burden. By extrapolating the excretion curve to time zero, the initial body burden (~0.01 μCi) and the life-dose (~0.5 Rem) to the critical organ (spleen) were calculated. (auth)

24617 (UCRL-50007-68-2) HAZARDS CONTROL PROGRESS REPORT NO. 31, MAY-AUGUST 1968. (California Univ., Livermore. Lawrence Radiation Lab.). Contract W-7405-eng-48. 68p. Dep. CFSTI.

Separate abstracts were prepared for each of the eleven sections presented. (B.G.D.)

For abstracts of individual sections see: 24432-24439, 24470, 24489, and 24679.

24618 CONTINUOUS MONITORING OF THE γ-n-FIELD OF THE VERTICAL BIOLOGICAL CHANNEL OF THE VVR-M REACTOR. Postnikov, L. N. (Inst. of Physics and Tech., Leningrad). Radiobiologiya, 9: No. 1, 144-50(1969). (In Russian).

A system of continuous monitoring of the γ-n-field of the vertical biological channel of the VVR-M reactor, permitting a monitoring of rapid and systematic changes in the dose rates of the γ- and n-components in the rotating volume of the biochamber both during preparation for the experiment and during the irradiation of animals, is described. The use of a continuous system of cameras in the system ensures stable effectiveness of the cameras and permits the use of the system for working measurements without prolonged preparations. Measurements of the mutual shielding during irradiation of large groups of mice in a γ-n-field were performed.

The theoretically possible limit of filtration of the γ-component during the irradiation of mice in "pure" neutron fields was determined. (JPRS)

24619 THE MEASUREMENT OF THE DOSE CAPACITY IN THE RADIUM CONTACT IRRADIATION OF BILATERAL VOCAL CARCINOMAS. Jatho, K. (Medizinische Akademie, Luebeck). HNO, 15: 349-51(Nov. 1967). (In German).

The rare cases of bilateral vocal carcinoma suitable for radium contact irradiation present special problems of radiation dose determination and the arrangement of the radium holder to the vocal cords. The two plate carriers, as they are used for contact irradiation of unilateral vocal carcinomas, are charged with 10 mg Ra and are left in position for 120 hrs. By spacing of similar radium holders with a trapezoid container, the danger to the anterior commissure can be lessened without limiting the therapeutic dose to the vocal carcinoma. (tr-auth)

24620 STUDIES ON THE OCCURRENCE OF NEUTRONS IN THE KIDNEY. Wszolek, B.; Majewski, C.; Kukiel, E. Pol. Med. J., 7: 723-9(1968).

Translated from Patol. Pol., 18: No. 2, (1967).

This study was undertaken to ascertain whether, apart from the previously demonstrated neutron fission of ^{238}U, presence of neutrons can be detected on the basis of their ability of eliciting nuclear reactions with the nuclei of atoms of some elements. The method of tracer autoradiography was employed. Lithium borate was incorporated into the nuclear emulsion. After six-week's exposure, in both substrates, i.e., in the human kidney removed surgically because of clear-cell carcinoma and in the kidneys of rats with transplantable Guerin epithelioma, nuclear reactions initiated by fast neutrons were recorded. On the basis of the energy and mass conservation law, the energy of particles from the disintegration of the ^{10}B nucleus and energy of the neutron taking part in the reaction were calculated. Disintegration of the stimulated complex ^{8}Li nucleus to three charged particles, presumably formed in the reaction of the neutron with the ^{7}Li nucleus was also observed. (auth)

24621 ^{90}Sr IN DECIDUOUS TEETH, DIET, AND BONE. Aarkrog, Asker (Danish Atomic Energy Commission, Risoe). Nord. Med., 79: 280-2(Feb. 29, 1968). (In Danish).

Since 1953, ^{90}Sr has been detectable in all types of shed deciduous teeth. Between that year and 1958 the level increased fourfold. Second molars contained more ^{90}Sr than did incisors and first molars. Faeroe-Island teeth contained four times as much ^{90}Sr as did teeth from Denmark and Greenland; there was no significant difference in this respect between Danish and Greenlandish teeth. The variation between the different areas was proportional to the ^{90}Sr levels in a diet consisting of 75% milk and 25% total adult food from these areas. The mean level of ^{90}Sr in shed deciduous teeth may provide an acceptable estimate of the bone level of ^{90}Sr in the one-year-old tooth donor. (auth)

24622 INFLUENCE OF THE PHYSICO-CHEMICAL FORM OF RUTHENIUM ON CONTAMINATION OF MARINE ORGANISMS. Gueguenlat, Pierre; Bovard, Pierre; Ancellin, Jacques (Departement de la Protection Sanitaire, Cherbourg, France). Compt. Rend., Ser. D, 268: 976-9(Feb. 10, 1969). (In French).

The derivatives of ruthenium nitrosyls in the effluents of plants for treatment of irradiated fuel elements were found in seawater in various physico-chemical forms, anionic, cationic, intermediate, and particulate. Concentration factors were determined for the algae, Chondrus crispus and Corallina officinalis, and the invertebrates, Actinia equina, Leander serratus, and Mytilus sp. It was found that the particulate form of ruthenium was chiefly responsible for contamination of marine organisms. (H.L.W.)

24623 RADIATION PROTECTION. I. Fuji, Takashi. Anzen Kogaku, 7: No. 2, 112-18(June 1968). (In Japanese).

The reduction of radiation hazards from the industrial utilization of radiation is stressed. Radiation protection is discussed in relation to units used for the radiation, radiation sources, radiation injuries, and their characteristics, and symptoms of the radiation injuries. (NSA of Japan)

24624 DIAGNOSIS AND TREATMENT OF DEPOSITED RADIONUCLIDES. Proceedings of a Symposium held at Richland, Wash., 15-17 May 1967. Kornberg, H. A.; Norwood, W. D. (eds.). Monographs on Nuclear Medicine and Biology, No. 2. Amsterdam, Excerpta Medica Foundation, 1968. 697p. $42.00. (CONF-670521).

Separate abstracts were prepared for 62 of the papers presented in this symposium. The papers are categorized under the following headings: sources of radionuclides, properties of radionuclides in tissues, bases of diagnostic procedures, fundamentals of treatment for deposited radionuclides, statistics on human cases, problems of the future, health physics and medical practices, and legal and administrative problems. (E.R.B.)

For abstracts of individual papers see: 24533–24550, 24625–24667, and 24694.

24625 RADIONUCLIDES IN THE ENVIRONMENT. Eisenbud, Merril (New York Univ., N. Y.). Monogr. Nucl. Med. Biol., No. 2, 3-18(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Although traces of fission and activation products can be detected in our environment and in some cases in human food and tissues, the dose from these nuclides is small compared with that received from the naturally occurring radionuclides. Essentially all of the environmental contamination to date is due to the testing of nuclear weapons; contamination from industrial sources is minimal and is localized near a few large atomic energy facilities. There is ample evidence that modern technology is more than adequate to deal with the potential risks of radioactive materials, and that the minimal amounts of radioactive contamination that results from the use of nuclear reactors and other civilian applications of atomic energy involve negligible risks for which, in return, there are tangible benefits. Perhaps the greatest benefit from the use of nuclear power is that as a substitute for fossil fuels it helps to reduce air pollution. The use of unsealed sources of ionizing radiation like the use of nuclear power, has been subject to excessive conservatism. There are enormous benefits to be derived from the use of shortlived γ emitters to measure diffusion coefficients in rivers and bays and to study the diffusive properties of the atmosphere. There are many potential uses of radioisotopes as leak detectors in chemical processes. More widespread use of unsealed sources of radioactivity would result in some degree of environmental contamination but there is sufficient knowledge about the behavior of radioactive substances in the environment to permit controlled releases of uncontained sources under conditions that could produce no harm and would result in substantial benefits to mankind. (auth) (TSS)

24626 RADIONUCLIDE BURDEN-DIET RELATIONSHIPS NEAR A NUCLEAR FACILITY. Honstead, J. F. (Battelle-Northwest, Richland, Wash.). Monogr. Nucl. Med. Biol., No. 2, 19-30(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Radioactive waste effluents released from Hanford plant facilities during their operation represent the controlled release of low-level waste for which concentration and storage is not feasible. The discharge includes cooling water from the Hanford reactors, waste water from research facilities, and gaseous effluents released from stacks. Low-level liquid waste discharged to the ground at Hanford also represents release of radioactive effluent but up to now these materials are contained underground and are not measurable off-plant. Some of the radioactivity from the various effluents become diffused through the local environs and may be incorporated in locally produced foodstuffs in measurable concentrations. The radionuclides in drinking water and foods, as they are deposited in human tissues, represent a potential contribution to the dose of individuals living adjacent to the Hanford plant. As part of the environmental evaluation, the annual dose received by people living in the plant environs, including the contribution of radionuclides deposited at some equilibrium concentration in tissues was regularly estimated. This evaluation was limited to that dose contribution by radioactivity from the Hanford plant. (auth)

24627 RADIONUCLIDE CONTAMINATION ENCOUNTERED IN PERSONNEL OPERATING A CYCLOTRON WITH 50 MeV PROTONS. MacDonald, N. S.; Hayes, M.; James, E. (Univ. of California, Los Angeles). Contract AT(04-1)-GEN-12. Monogr. Nucl. Med. Biol., No. 2, 31-6(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Whole-body counting of cyclotron workers at intervals over a year's time disclosed traces of body contamination with ^{7}Be, ^{54}Mn, and ^{65}Zn. Foam phantoms to simulate the human lung in size and density and sugar to simulate the body, were used to calibrate the body counter for three possible contamination situations; a small spot on the surface of the hands; a single particle embedded in a lung; and a uniform distribution throughout a lung. Estimates of the body burdens of the three nuclides were below one microcurie in all cases. (auth)

24628 PROPERTIES OF RADIONUCLIDES IN TISSUES. A NEW LOOK AT SOME OLD PROBLEMS. Thompson, Roy C. (Battelle-Northwest, Richland, Wash.). Monogr. Nucl. Med. Biol., No. 2, 39-44(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Methods for determining the properties of radionuclides in tissues have changed in the past decade. The major point under discussion is the level of sophistication now present in these methods. This discussion serves as an introduction to the section on properties of radionuclides in tissues. (E.R.B.)

24629 DISTRIBUTION OF SOME ACTINIDES IN BLOOD SERUM PROTEINS. Popplewell, D. S.; Boocock, G. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Monogr. Nucl. Med. Biol., No. 2, 45-55(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The combination of plutonium, americium, and curium with blood sera from rats and humans was studied. The separation of the blood serum proteins by gel permeation chromatography and ion exchange chromatography is described. Distribution patterns of the actinides under study are presented in graphical form. (E.R.B.)

24630 PREPARATION, CHARACTERIZATION, AND DISTRIBUTION IN MOUSE TISSUES OF GRADED POLYMERIC AND MONOMERIC PLUTONIUM. RADIOCHEMICAL AND AUTORADIOGRAPHIC STUDIES. Lindenbaum, A.; Lund, C.; Smoler, M.; Rosenthal, M. W. (Argonne National Lab., Ill.). Monogr. Nucl. Med. Biol., No. 2, 56-64(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Solutions of plutonium (IV) nitrate, adjusted to pH 5.5 to 6.0 and stabilized with citrate, were fractionated with respect to particle size by passage through Sephadex columns. Three graded solutions of narrow particle size range thus obtained, in which the fraction of plutonium ultrafilterable through cellophane membranes was <1%, 30%, and 100% respectively, were injected intravenously into mice. At sacrifice, five days later, livers, spleens, femurs, and tibial shafts (the latter separated into hard bone and marrow fractions) were removed for plutonium analysis and autoradiography. With increasing ultrafilterability, less plutonium was deposited in liver, spleen, and marrow, while more was deposited in bone. Injection of the graded solution containing 30% ultrafilterable plutonium, from which both larger and smaller particles were removed, resulted in a significantly different organ distribution of plutonium as compared with previously used, ungraded, solutions of the same ultrafilterability. With the graded solutions, the greatest differences in tissue deposition were found between the most polymerized plutonium and the two less polymeric forms. The pattern of deposition in mouse tissues thus appears to depend on aggregation of plutonium-containing particulates to some critical particle size. Filtration of plutonium solutions through calibrated Millipore filters indicated that this critical size was below 0.5 μ and well above 0.01μ in diameter. Quantitative autoradiography of livers from mice given graded polymeric plutonium showed differences in deposition between parenchymal and littoral cells (60% v. 40%, respectively); the ratio was larger (70% v. 30%) after the graded monomeric solution. Stars in both liver and spleen were seen only after the most polymeric solution. (auth)

24631 AN AUTORADIOGRAPHIC STUDY OF THE CHANGES IN DISTRIBUTION OF POLYMERIC PLUTONIUM IN MOUSE TISSUES. Lindenbaum, A.; Rosenthal, M. W.; Smoler, M. (Argonne National Lab., Ill.). Monogr. Nucl. Med. Biol., No. 2, 65-72(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Mice injected intravenously with 0.2 μCi of polymeric plutonium were sacrificed at intervals between 0.5 hr and 89 days. The distribution and localization of plutonium α activity in kidney, spleen, liver, and bone marrow were determined by quantitative autoradiography. In the kidney, up to six hrs after injection of plutonium, there was four times as much plutonium in the glomeruli as in the tubules. As observed up to five days in the spleen, the plutonium was concentrated in increasing amounts in the perifollicular zones of the red pulp. In the liver, about 60% of the tracks were associated with parenchymal cells, and 40% with littoral cells, at all intervals from 0.5 hr to 89 days. Progressive aggregation of plutonium in liver was indicated by the appearance of stars between one and five days, and by an increase in the size of stars thereafter. The plutonium concentrations in the liver, based on track counts, were in agreement with those obtained by gross radiochemical assay. (auth)

24632 AUTORADIOGRAPHIC AND RADIOCHEMICAL STUDIES OF THE EFFECT OF COLLOIDAL STATE OF INTRAVENOUSLY INJECTED PLUTONIUM ON ITS DISTRIBUTION IN BONE AND MARROW. Rosenthal, M. W.; Marshall, J. H.; Lindenbaum, A. (Argonne National Lab., Ill.). Monogr. Nucl. Med. Biol., No. 2, 73-80(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Radiochemical and autoradiographic evidence is presented showing that there was appreciable deposition of plutonium in bone marrow six days after intravenous injection into mice, that remained for at least three months. The amount of plutonium in the marrow, and its degree of aggregation, were greater, and the amount of plutonium on bone surfaces was smaller, after injection of polymeric than monomeric plutonium. Although the amount of plutonium in the marrow was appreciable, it was always less than that deposited on the bone surfaces. (auth)

24633 BASES FOR THE DETECTION AND MEASUREMENT OF DEPOSITED RADIONUCLIDES. Pochin, E. Eric (University Coll. Hospital Medical School, London). Monogr. Nucl. Med. Biol., No. 2, 127-34(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Methods are available for many nuclides, either for detecting relatively simply whether a substantial contamination may have occurred, or by more detailed and prolonged investigation, the approximate scale of the contamination and the tissue dose commitments involved. There is need for work to simplify techniques to increase their sensitivity in some cases, and to cover a wider range of relevant nuclides and different forms of selective localization. A high accuracy in determining the exact level of body burdens is, however, probably of less urgency in protection work, provided that body burdens are as a whole being kept to levels substantially below the maximum permissible. (auth)

24634 THE ESTIMATION OF INTERNAL RADIATION DOSE FROM METABOLIC AND EXCRETION DATA FOR ^{60}Co, ^{59}Fe, ^{54}Mn, AND ^{65}Zn. Freke, A. M.; Duncan, K. P. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Monogr. Nucl. Med. Biol., No. 2, 135-51(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Retention and excretion functions were derived for radioisotopes in the human body. On the basis of these derived functions, suitable investigation levels were derived for ^{60}Co, ^{59}Fe, ^{54}Mn, and ^{65}Zn. Estimates of internal radiation dose were as follows: ^{60}Co; 3 nCi/day with respect to urine (>70 days), ^{59}Fe; 10 nCi/day based on whole-body counting methods, ^{54}Mn; 3 nCi/day with respect to total excretion (>100 days), and ^{65}Zn; 2.5 nCi/day with respect to urine (>140 days). (E.R.B.)

24635 THE DETERMINATION OF THE DEPTH AND AMOUNT OF ^{239}Pu IN WOUNDS WITH Si(Li) DETECTORS. Palmer, H. E.; Wogman, N. A.; Cooper, J. A. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Monogr. Nucl. Med. Biol., No. 2, 164-70(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The Si(Li) detector used in these experiments and wound cases was a general purpose model and was not built specifically for determining Pu in wounds. The use of the Si(Li) detector did not increase the sensitivity for the measurement of Pu in wounds even though it had a lower background. The background from an uncontaminated hand or forearm was greater than that of the detector alone and, therefore, limited the background reduction. However, greater sensitivity is not needed in wound counting. The real usefulness of the counter is in the more accurate measurements of the total activity and an indication of the depth of the Pu in the wound. This will give the health physicist more confidence in this type of measurement and will be useful to the physician who removes the activity. The one remaining problem in this type of measurement is that of relating the X-ray count to the α particle disintegration rate where the isotopic composition of the Pu is not known. With increasing size of the Si(Li) diodes or the use of an array of several diodes, the determination of Pu in lungs, liver, and other organs of the body should be possible with greater accuracy by using the superior resolution to estimate the depth and absorption of the x and γ rays from the Pu and associated ^{241}Am. (auth) (TSS)

24636 THE MEASUREMENT OF ^{239}Pu IN VIVO. A PROGRESS REPORT. Ramsden, D.; Speight, R. G. (Atomic Energy Establishment, Winfrith, Eng.). Monogr. Nucl. Med. Biol., No. 2, 171-88(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The problem of the measurement in vivo of the lung content of insoluble ^{239}Pu was the subject of investigation at the Atomic Energy Establishment, Winfrith, during the past three years. A prototype monitoring equipment, consisting of a low background

xenon-filled multiwire proportional counter, used in conjunction with a large area thin-windowed sodium iodide crystal, was developed for this purpose. This equipment was used to make measurements on a small number of subjects with lung burdens of ^{239}Pu around or in excess of the present detection limit of about 0.012 μCi. Calibration factors for the detectors under different geometric conditions were obtained by using a chest phantom. The equipment and techniques that were used, and the many sources of error inherent in such measurements are discussed. (auth)

24637 IN VIVO MEASUREMENTS OF NUCLIDES EMITTING SOFT PENETRATING RADIATIONS. Laurer, G. R. (New York Univ., Tuxedo); Eisenbud, Merril. Monogr. Nucl. Med. Biol., No. 2, 189-207(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The results of experiments utilizing a 1 mm thick CsI(Tl) crystal in conjunction with a NaI(Tl) crystal anti-coincidence system for the quantitative in vivo assessment of body burdens of low energy photon emitters such as ^{239}Pu, ^{90}Sr, ^{210}Pb, and natural and enriched uranium are presented. Measurements done to obtain optimum crystal thickness, using S^2/B as a figure of merit, have shown a thickness of 1 mm to be a practical compromise for all three nuclides. The use of this thin crystal in conjunction with a NaI(Tl) crystal anti-coincidence system using rise-time discrimination is effective in reducing background in the low energy region by approximately 70%, and the Compton continuum of ^{137}Cs by as much as 70%. The use of this system led to the development of a prototype, portable in vivo counter with an 8" diameter by 1 mm thick CsI(Tl) detection crystal and an 8" diameter by 2" thick NaI(Tl) anti-coincidence crystal. Calibration measurements performed with the large crystal have shown minimum significant measurable levels of activity (MSA's) that indicate that body burdens, more particularly lung burdens, may be measured at a fraction of the M.P.B.B. without the use of a steel room. (auth)

24638 INTERPRETING COUNTING DATA FOR INTERNALLY DEPOSITED PLUTONIUM. Swinth, K. L. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Monogr. Nucl. Med. Biol., No. 2, 208-21(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Rapid indications of inhaled amounts of plutonium at levels near the Maximum Permissible Body Burden (40 nCi) are possible with present equipment. This equipment, coupled with the enhancement of sensitivity by radiations from the rapidly eliminated portion of the inhaled material, will yield information on exposed individuals who may have a retained body burden constituting a fraction of an MPBB. The sensitivity can be enhanced by a factor of five. Unfortunately, this enhancement is variable to a degree depending on exposure conditions. The use of ^{241}Am as a tracer is less affected by the many variables present and should yield greater sensitivity for many isotopic compositions. Initial results will depend heavily on isotopic composition and will be hard to interpret without appropriate corrections. The use of ^{241}Am as a tracer requires one to assume that the translocation rates of ^{241}Am and plutonium are the same for counting to be performed after a significant lapse of time following an exposure. Because of the great sensitivity of the scintillation counter and the ability to efficiently count both the x rays and ^{241}Am γ rays, the use of these counters appears more promising than other methods. Proportional counters and, in the future, solid state detectors are excellent for high-resolution x-ray detection and low background rates, but the problems in interpretation of data still exist. Both of the latter systems have reduced efficiencies at 60 keV. Proportional counters are presently in use and the limit on the use of silicon detectors, at the present, is the cost of such a system. Whole-body count data compare favorably with data obtained from bioassay methods. Accurate bioassay results require multiple sampling, and in the case of injected material under ideal conditions, an accuracy of 25% has been quoted. The expected accuracy from inhalation exposure will be worse than this since the quantity excreted and the rate of excretion vary greatly depending upon particle size and the nature of the material inhaled. Health physics application of plutonium whole-body counting is limited by the variables and the understanding of these variables, but important information can be derived from such counting data. It appears that the use of ^{241}Am as a tracer may be more valuable in health physics work than attempting to count the x rays from plutonium. This will not be the case for material high in ^{239}Pu content or recently separated from ^{241}Am. (E.R.B.)

24639 BIOASSAY EXPERIENCES IN SUPPORT OF FIELD OPERATIONS ASSOCIATED WITH WIDESPREAD DISPERSION OF PLUTONIUM. Odland, L. T.; Thomas, R. G.; Taschner, J. C.; Kaufman, H. R.; Benson, R. E. (Air Force Radiological Health Lab., Wright-Patterson AFB, Ohio). Monogr. Nucl. Med. Biol., No. 2, 256-65(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Bioassay experiences associated with the Palomares nuclear accident indicate that, in spite of the many handicaps of field operations, personnel protection and decontamination procedures were effective. The exercise demonstrated that modern communication and transportation facilities permit one well-equipped and staffed laboratory to provide adequate support for an incident of this nature anywhere in the world. Of nearly 1,600 participants, less than 20% have a systemic body burden of plutonium detectable by urinary bioassay, and of this number, only 25 showed a value in the range of 7 to 67% of one permissible body burden. Provisions were made for long-term follow-up on the group of 25 as well as collection and study of autopsy material as it becomes available. Based on available methods for estimation of systemic body burden of ^{239}Pu following an inhalation exposure, not one individual who participated in the Palomares operation has demonstrated systemic retention exceeding the maximum permissible amount. (auth)

24640 THEORETICAL EXCRETION OF PLUTONIUM IN URINE BASED ON THE NEW ICRP LUNG MODEL. Nelson, Iral C. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Monogr. Nucl. Med. Biol., No. 2, 266-78(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The new ICRP lung model is a significant advance in establishing a rational basis for internal depositions from inhalation of radioactive aerosols. In the case of plutonium nitrate and plutonium oxide, estimates of lung and systemic burdens can be made from urine or fecal analysis for plutonium if the particle size distribution is known. Less satisfactory, but in some instances adequate, estimates of lung and systemic burdens can be made at long times after intake without particle size data. Data from urinary excretion of plutonium are adequate to estimate systemic burden regardless of particle size at about one month after intake for plutonium nitrate and at about one year for plutonium oxide. Carefully performed analysis of feces for plutonium offers considerable increase in sensitivity over the urinalysis method for the estimation of lung burdens. The approach here to estimation of body burdens by analyses of body excretion for plutonium was strictly theoretical and assumed the new lung model to be accurate in all respects. In the absence of experimental evidence to the contrary it is recommended, however, that these excretion results be used in the assessment of internal depositions. Because of the large dependency on particle sizes, estimates of lung and systemic burden require better characterization of the air inhaled by the worker. In addition to continued emphasis on exposure prevention, instrument technologists should be encouraged to develop personal air characterization devices that will permit more reliable estimates of lung and systemic burdens to be made. (auth)

24641 THE USE OF EXCRETION DATA TO PREDICT THE SYSTEMIC BODY BURDEN OF PLUTONIUM. Snyder, W. S.; Ford, M. R.; Warner, G. G. (Oak Ridge National Lab., Tenn.). Monogr. Nucl. Med. Biol., No. 2, 279-90(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Urinary excretion formulas are derived for use in the statistical analysis of excretion data to determine the systemic body burden of plutonium in man following an inhalation experience. These data can be used to design a computer program that will produce an estimate of the plutonium intake and amount present in the body during and after exposure, taking into account daily fluctuations in urinary excretion. Experiences with the use of the program indicate that it is a definite improvement over methods of estimation that neglect the influence of fluctuation on the excretion data. (E.R.B.)

24642 PROPERTIES OF CHELATED RARE EARTHS IN TISSUES AND BLOOD. Lafuma, J. C. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Monogr. Nucl. Med. Biol., No. 2, 294-7(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

To help resolve whether tropical application of chelating agents is indicated for wounds contaminated with such radionuclides as rare earths, the percentage of the rare earth fraction diffused from wounds, the diffusion rate of various rare earths in tissue, and the fate of several complexes of rare earths in the blood were measured. Measurements made after intramuscular injection of chlorides at pH 1 showed that: for cerium, 5% diffuses within a few minutes, while for lutetium, only 0.5% diffuses.

Inhalation studies showed the same ratio of 10 between cerium and lutetium, but the fraction of diffused lutetium varied from 3% to 5%. To study the behavior of a locally formed complex when it is diffused into the blood, complexes from increasing amounts of various organic anions were prepared before injection. When complexes were injected intravenously, two very different metabolisms were obtained: The first one was linked to the exchanges that occur in the blood plasma. This process resulted in a binding between the proteins and rare earth. The exchanged fraction varied according to the nature and concentration of the chelating agent used. Experiments with various complexes at several concentrations in the injected solution using ^{144}Ce complexed with lactic, tartaric and citric acids, EDTA, and DTPA were performed. The results demonstrated that the breaking down of complexes in the body was dependent only on the stability of the complex and its concentration in the plasma. With rare earths, the stability of the complexes increased from cerium to lutetium. As to the treatment of wounds contaminated with rare earths, the experimented results indicate: first, the magnitude of the instantaneous diffusion decreases from lanthanum to lutetium—hence, the local use of a chelating agent must always be as early as possible— but the effectiveness of the treatment will decrease from cerium to lutetium. Next, the stability of the complex in the body will depend on the nature and concentration of the chelating agent. The best chelating agent is DTPA. When amounts of about 1 g are used in man, the rare earths complexed with chelates are fully eliminated. (E.R.B.)

24643 REPRESSIVE ACTION OF SODIUM ALGINATE ON ABSORPTION OF RADIOACTIVE STRONTIUM AND CALCIUM IN CATS. Stara, J. F.; Waldron-Edward, D. (Public Health Service, Cincinnati). Monogr. Nucl. Med. Biol., No. 2, 340-54(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Experiments were conducted to demonstrate that alginate added to a regular diet significantly suppressed absorption of ^{85}Sr in cats. The suppression was most successful when the animals received the supplement at approximately the same time as the radioactive dose. Ingested sodium alginate also removed radiostrontium that had been resecreted into the intestinal tract from the endogenous cycle. The effect was seen in cats that received a single intravenous dose; body burden of chronically labelled cats was reduced more slowly to about the same extent. Sodium alginate in the diet also removed stable strontium preferentially, as could be seen in a reduction of the proportion of Sr^{++}/Ca^{++} in femurs and teeth. In cats fed with sodium alginate for 260 to 300 days, the bones of experimental animals contained one-half the stable strontium found in control animals. The long-lived fission product, ^{90}Sr was equally affected by sodium alginate as the shorter-lived isotopes. Autoradiograms of the femurs of cats fed with ^{90}Sr for four weeks indicated a reduction of as much as 80% in animals receiving alginate. (auth)

24644 NEPHROTOXICITY OF CHELATING AGENTS. Foreman, H.; Nigrovic, V. (Univ. of Minnesota, Minneapolis). Monogr. Nucl. Med. Biol., No. 2, 419-23(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The toxicity of MnDTPA to rats as measured by lethality was significantly lower than that of the Ca chelate. The effect was less marked in the case of the EDTA chelates. Likewise the toxicity of the Mn chelates using renal tubular findings as the end point was much lower than the Ca chelates. Managanese(II) given along with the CaDTPA did not influence the toxicity of CaDTPA. Apparently it was a transient depletion of tubular tissue Mn(II) and a temporary inhibition of Mn activated enzyme that was involved that could not be replenished or rectified by concurrent administration of manganese. (auth)

24645 A STATISTICAL SUMMARY OF UNITED STATES ATOMIC ENERGY COMMISSION CONTRACTORS' INTERNAL EXPOSURE EXPERIENCE 1957–1966. Ross, Donald M. (Atomic Energy Commission, Washington, D. C.). Monogr. Nucl. Med. Biol., No. 2, 427-34(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

A statistical summary is presented of the internal radionuclide deposition cases among USAEC contractors during 1957 through 1966. Statistics are presented on radionuclides involved, methods of detection, route of entry, method of estimation of plutonium burden, and kind of treatment for plutonium cases. The radionuclides involved were: ^{235}U, $^{238-239}Pu$, ^{210}Po, ^{131}I, ^{133}I, ^{135}I, and ^{90}Sr. (E.R.B.)

24646 A STATISTICAL SUMMARY OF UNITED STATES ATOMIC ENERGY COMMISSION LICENSEES' INTERNAL EXPOSURE EXPERIENCE, 1957–1966. Roeder, J. R. (Atomic Energy Commission, Washington, D. C.). Monogr. Nucl. Med. Biol., No. 2, 435-50(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

A statistical summary is presented of the internal radionuclide deposition cases among licensees of the USAEC during 1957 to 1965. Data are presented in tabular form on the physical and chemical characteristics of the isotope involved, route of entry, kind of operation, method of dose measurement, site of internal deposition, and treatment instituted. The radioisotopes involved include a variety of fission products and therapeutic radioisotopes. (E.R.B.)

24647 A SUMMARY OF UNITED STATES EXPOSURE EXPERIENCES IN THE URANIUM MINING INDUSTRY. Holaday, D. A.; Archer, V. E.; Lundin, Frank. Monogr. Nucl. Med. Biol., No. 2, 451-6(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Data on exposure experiences among personnel in uranium mines in the United States are summarized for the period during 1956 to 1966. Environmental as weil as epidemiological studies are included in the summary. The major exposure rates and contamination levels were the result of inhalation of the radon daughters present on dust particles in the mine atmosphere. Data on cancer incidence and death rates among uranium miners are also presented in tabular form. (E.R.B.)

24648 STATISTICAL INVESTIGATION INTO AMOUNTS OF RADIONUCLIDES ACCIDENTALLY INHALED. Franke, Th.; Hunzinger, W. (Eurochemic, Mol, Belg.). Monogr. Nucl. Med. Biol., No. 2, 457-9(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The results of a statistical investigation of the amounts of radionuclides accidentally inhaled by nuclear laboratory personnel. The data are presented in terms of the inhaled fraction of the total activity handled (IFTAH). Also included in the data are presence or absence of glove boxes, ventilation characteristics of the area, nature of the activity, and temperature of the activity source. Of the conclusions drawn from the data, the most striking is that the IFTAH was independent of the type of accident leading to the inhalation. (E.R.B.)

24649 TISSUE ANALYSIS FOR PLUTONIUM AT AUTOPSY. Newton, C. E. Jr.; Larson, H. V.; Heid, K. R.; Nelson, I. C.; Fuqua, P. A.; Norwood, W. D.; Marks, S.; Mahony, T. D. (Batelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Monogr. Nucl. Med. Biol., No. 2, 460-8(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Results of investigations indicate that of those cases sampled at autopsy since 1962, the predominant source of contamination was not from occupational sources, but was more likely from weapons testing fallout. In the absence of case data to the contrary, the results suggest that workers were not exposed at the chronic levels assumed and that, in fact, the air breathed at work locations was in general substantially cleaner than particle distribution and concentration analysis predicts. For those individuals sampled, the autopsy program demonstrated that work in a plutonium facility could be and was performed without incurring appreciable burdens of plutonium. Samples taken included a sizeable portion of tissue from the left lung including tissue of the hilar lymph nodes, approximately 200 g of liver and the sternum. In special cases, the tracheobronchial lymph nodes were obtained and analyzed separately. The total organ weights were taken to permit better relative comparison of plutonium distribution within an individual. As in most investigations of this kind, the need for data continues and exchange of similar data and conclusions with other plutonium handling facilities is urgently sought. (auth)

24650 MAGNITUDE OF DEPOSITED RADIONUCLIDE PROBLEM BASED ON FUTURE USAGE: CIVILIAN ASPECTS. Doran, W. T. (Atomic Energy Commission, Washington, D. C.). Monogr. Nucl. Med. Biol., No. 2, 471-81(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The continuing expansion of the nuclear energy industry and the increasing production of radionuclides in isotope development, power reactors, and in many peaceful uses of nuclear energy, carry within them the potential of an escalating problem of health and safety. On the other hand, planning for prevention of such problems has long been the established practice in the industry. The magnitude of the potential problem in terms of known areas in which there will be future civilian usage, and the practical problem of health and safety requirements are reviewed. In broad terms, the future uses of this increased production of

radionuclides can be categorized as: source of heat and power, medical diagnostic and therapeutic applications, improvements in general technology including industrial and agricultural, and new applications in scientific research. The relative significance, dispersion of operations, number of individuals involved, and size of community affected in each of these categories vary greatly. (auth)

24651 MAGNITUDE OF DEPOSITED RADIONUCLIDE PROBLEM BASED ON FUTURE USAGE: DEFENSE ASPECTS. Tedford, C. F. (Bureau of Medicine and Surgery, Washington, D. C.). Monogr. Nucl. Med. Biol., No. 2, 482-6(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The Navy has become one of the largest users of nuclear energy within the United States. Nuclear energy is widely used within the Navy for nuclear propulsion, medical diagnostic and therapeutic purposes, research application, and nuclear weapons. In relation to these applications and the continued expansion of radioisotope applications, the problems of radiation safety and radioisotope deposition are reviewed from the defense standpoint. (E.R.B.)

24652 A CASE OF INTERNAL CONTAMINATION WITH ^{231}Pa AND ^{227}Ac VIA A PUNCTURE WOUND. Newton, D.; Rundo, J.; Sandalls, F. J. (Atomic Energy Research Establishment, Harwell, Eng.). Monogr. Nucl. Med. Biol., No. 2, 521-33(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

A chemist accidentally drove a piece of fine glass tubing into the palm of his left hand, where it remained for 34 days before removal by surgery. The glass was contaminated with ^{233}Pu and ^{227}Ac et seq. The techniques used to locate and assess the activity remaining near the site of the wound are described, and the results of body radioactivity measurements and excretion analysis are presented for the first 1,000 days. Initially 98 nCi ^{227}Ac were present in the hand, of which 58 nCi were recovered with the glass. Most of the remainder migrated from the hand, resulting in a systemic burden of 36 nCi after 600 days; this is being released very slowly, with a biological half-life in excess of 10 years. Virtually all of the ^{227}Th daughter nuclide in vivo, but 30% of the ^{223}Ra produced in the body was excreted. Less conclusive results were obtained about the ^{231}Pa burden. 17 nCi were removed with the glass, approximately 7 nCi remained in the hand after 600 days, and 16 nCi were excreted, but the amount initially present in the hand and the current body content are uncertain. (auth)

24653 ASSESSMENT OF TRITIUM IN MAN. Sanders, S. M. Jr.; Reinig, W. C. (Savannah River Lab., Aiken, S. C.). Contract AT(07-2)-1. Monogr. Nucl. Med. Biol., No. 2, 534-42 (1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Methods for assessing the content of tritium in man based on urinary excretion data are discussed. Accurate evaluation of the radiation dose from tritium in man is becoming more important in view of the increased application of this radionuclide and its increased production by ternary fission and neutron capture in heavy water moderator in nuclear reactors. Data on tritium assimilation in the body following exposure are presented in tabular form. (E.R.B.)

24654 HEALTH PHYSICS APPLICATION OF IN VIVO GAMMA SPECTROMETRY IN A URANIUM PROCESSING PLANT. Scott, L. M.; West, C. M. (Union Carbide Corp., Oak Ridge, Tenn.). Contract W-7405-eng-26. Monogr. Nucl. Med. Biol., No. 2, 543-52(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

In vivo gamma spectrometry has been used routinely for the past six and a half years in the health physics monitoring of uranium processing workers. The major problems associated with the technique are: effects of surface contamination, relative insensitiveness of the methods, and the difficulty of predicting the base spectrum in the uranium region. The solutions to the problems at Y-12 were to: use the back detector data when contamination was indicated, increase the number of detectors, and derive a prediction equation and count a control population to assure continued reliability of the equation. Experience has shown that urinalysis will not point out all exposure cases and that generally once a person was removed from uranium exposure, the urine level will return to acceptable levels long before in vivo measurements did. Consequently, it was concluded that in vivo spectrometry is superior to urinalysis as a monitor for insoluble uranium. However, for soluble uranium and areas of low exposure potential, urinalysis is of real value. (auth)

24655 URINE AND TISSUE CONTENT OF ^{210}Pb AND ^{210}Po IN URANIUM MINERS. Archer, V. E.; Black, S. C.; Dixon, W. C.; Saccomanno, G. (National Center for Urban and Industrial Health, Salt Lake City). Monogr. Nucl. Med. Biol., No. 2, 553-74(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Urine and tissue samples from uranium miners were analysed for ^{210}Po and ^{210}Pb. In urine samples obtained within a short period after exposure, there was a relationship between the exposure and both ^{210}Po and ^{210}Pb content of urine. In urine samples obtained some time after exposure, the ^{210}Po and ^{210}Pb content of urine showed better correlation with cumulative exposure to radon daughters. Tissues having the highest concentrations of ^{210}Po and ^{210}Pb were bone, kidney, lung, hilar lymph nodes, hair, and liver. In most tissues there was slightly more ^{210}Pb than ^{210}Po, but in kidney, liver, and hair this relationship was reversed. There appeared to be a change in the ratio between bone content of ^{210}Po and ^{210}Pb and that of soft tissue as the interval between last mining and tissue analysis was lengthened. Possibilities of using periodic analyses of urine and hair as a biological monitoring method for radiation exposure in mines were discussed. There are currently two deterrents to this use: the time and difficulties involved in present methods of analysis and the lack of a satisfactory quantitative correlation between exposure and analytical results. (auth)

24656 PROBLEMS IN INDEPENDENT MEDICAL MANAGEMENT OF PLUTONIUM–AMERICIUM CONTAMINATED PATIENTS. Wald, N.; Wechsler, R.; Brodsky, A.; Yaniv, S. (Univ. of Pittsburgh). Monogr. Nucl. Med. Biol., No. 2, 575-86(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Possible reasons for the special problems that occur in the medical management of industrial radiation accidents patients from commercial nuclear industry by private medical groups, as contrasted with those emerging from AEC Contractor industrial facilities and treated within their own industrial medical departments are considered. The most conspicuous difference is the lack of continuing direct responsibility on the part of independent groups for preparation for and management of this type of complex accident involving workers of various companies in commercial nuclear industry. This is evidenced by such facts as the absence of financial support for the acquisition of the special equipment and facilities made necessary by the particular operations of the companies which are using services such as ours; and the absence of any direct control by medical groups such as ours over the frequency and number of patient visits or bioassays to be performed on the part of the company whose worker is involved. Up to now, the AEC has concentrated its efforts in radiation medicine appropriately on its contractor medical operations. The Public Health Service has been more concerned with those radiation health problems involving the larger public. The state health departments have had neither the money nor the personnel to exercise their legitimate authority in this area. The commercial nuclear industry in general, therefore, has not yet accepted its major share of the responsibility to support the development before the accident, of the capabilities it will need after the accident. The universities and teaching hospitals, and some private practitioners, have thus far led the way in this area. It is proposed that the Atomic Energy Commission and the Public Health Service give consideration to the steps necessary to encourage state governments and commercial nuclear industry itself to join the universities and teaching hospitals and private practitioners, in accepting a realistic share of the responsibility, and the cost involved, in making good radiation medicine available to the growing number of workers in this field. (auth)

24657 CHELATING AGENTS IN PLUTONIUM DEPOSITION: A MINORITY VIEW. Schulte, H. F.; Whipple, H. O. (Los Alamos Scientific Lab., N. Mex.). Monogr. Nucl. Med. Biol., No. 2, 587-92(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The factors against routine use of chelating agents in plutonium exposure were as follows: The drugs were of a significant degree of toxicity. The administration of these agents made early evaluation of the seriousness of the incident difficult or impossible. The amounts of radioactive element mobilized in most clinical situations were not enough to be of real value. The effects on trace mineral metabolism and long term effects are not well known. The only drug currently recommended for this purpose cannot legally be used on humans in the United States. (auth)

24658 PROMPT MITIGATORY ACTION AFTER ACCIDENTAL EXPOSURE TO RADIONUCLIDES. Heid, K. R.; Henle, R. C.;

Selby, J. M. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Monogr. Nucl. Med. Biol., No. 2, 593-9(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

With the increasing use of radioisotopes in industry, improving the capabilities for prompt mitigating action, after an accidental exposure to radioisotopes, assumes greater importance. This is true for exposure to any radioisotope and especially plutonium, because of its extremely long life and selective deposition within the body. The steps taken by Radiation Protection personnel in the events of an accident during work with plutonium are described and the effectiveness of such mitigating action is demonstrated. (E.R.B.)

24659 MANAGEMENT OF THE EARLY PHASE OF RADIOACTIVE CONTAMINATION IN HUMAN BEINGS. Saenger, E. L. (Cincinnati General Hospital). Monogr. Nucl. Med. Biol., No. 2, 600-7(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The key to successful diagnosis and treatment of a contamination incident is promptness in dealing with the immediate event. Effective planning prior to the accident can eliminate much of the atmosphere both of uncontrolled radiation and of confusion that seem to exist for the first several hours following an accident. The characteristics of an effective emergency plan are: prompt recognition of possible contamination; adequate closure of the area after evacuation of the workers; prompt confinement, survey, and decontamination of the involved individuals; estimation of quantity of retained material, and development of further plans for decontamination. (E.R.B.)

24660 EXPERIMENTAL RADIOSURGERY FOR CARE OF INJURED RADIATING PATIENTS. Norwood, W. D.; Quigley, E. J. (Hanford Environmental Health Foundation, Richland, Wash.). Monogr. Nucl. Med. Biol., No. 2, 608-13(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

An experimental radiosurgery for care of injured radiating patients was described. It is hoped that it will not have to be used for its intended primary purpose. Additional cubicles may differ considerably from the first two as trial patient handling and continuing efforts suggest means for improvement. Secondary uses of the facility will be for teaching purposes and for developmental work to try to improve methods of measuring depositions of relatively insoluble plutonium within the lungs. (auth)

24661 THERE MUST BE A BETTER WAY TO DETERMINE COMPENSABILITY FOR RADIATION INJURY. Sterner, J. H. (Eastman Kodak Co., Rochester, N. Y.). Monogr. Nucl. Med. Biol., No. 2, 617-20(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Rather than continuing on the present haphazard basis, with controversy, confusion, and caprice as determined factors, it would seem worthwhile to develop a set of guidelines that could have the greatest impact on this increasingly important social problem. It might be desirable to bring together such diverse interests and competence as representatives from the International Association of Industrial Accident Boards and Commissions, the National Council on Radiation Protection and Measurement, the National Academy of Sciences, and knowledgeable contributors from government, labor, industry, and the medical and legal associations. While the recommendations from such a highly based body would not be legally binding, they could do much to bring needed order to a presently confused and chaotic situation. (auth)

24662 THE MEDICAL AND SCIENTIFIC BASIS FOR LEGAL LIABILITY RELATED TO RADIATION EXPOSURE. Collins, Vincent P. (Rosewood General Hospital, Houston, Tex.). Monogr. Nucl. Med. Biol., No. 2, 621-8(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The medical and scientific aspects of radiation injury as they may be brought to bear in civil suits for personal injury, in workman's compensation actions, or in the development and administration of legislation and regulations are considered. Decisions of the courts regarding legal liabilities are arrived at through a series of inflexible rules made flexible by exceptions, which are numerous in the case of radiation liability. The role of the legal witness in determining legal liability is also discussed. (E.R.B.)

24663 FACTS AND MYTHS ABOUT RADIATION INJURY CLAIMS. Hiestand, O. S. Jr. (Atomic Energy Commission, Washington, D. C.). Monogr. Nucl. Med. Biol., No. 2, 629-37 (1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

The procedures for prevention of radiation exposure, and the exposure data developed in such activities, are both important and valuable in legal proceedings relating to radiation injury claims. In workmen's compensation claims the development and preservation of adequate records of exposure are particularly important for the protection of both workers and employers. Although the causation problem is not unmanageable under existing rules, we should not be complacent about the social and economic considerations involved in potential radiation hazards. Rather than viewing radiation hazards as being unique and needing special treatment for tort and workmen's compensation law purposes, it is best to think that the expanding uses of radiation and nuclear energy are helping us catch up with modern-day needs. In this perspective, the atom is only a catalyst that has focused our attention on the need to consider the problems of late manifesting, non-specific diseases resulting from accidents or industrial hazards of any kind. (auth)

24664 WORKMEN'S COMPENSATION FOR LUNG CANCER IN URANIUM MINERS. Archer, V. E.; Thompson, H. C. (National Center for Urban and Industrial Health, Salt Lake City). Monogr. Nucl. Med. Biol., No. 2, 638-44(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Workmen's compensation awards were made in 15 cases out of 32 claims from a total of about 100 cases of lung cancer among United States uranium miners. Reports of decided cases are summarized and several legal and scientific problems reviewed. The legal doctrine of "preponderance of the evidence" in reaching a decision as to whether or not a particular lung cancer was a result of occupational exposure is discussed. Among the criteria used in deciding claims were cumulative exposure, concentration of ^{210}Pb in bone, amount and duration of cigarette smoking, time from start of uranium mining to diagnosis of lung cancer, age of claimant, and cell-type of the cancer. Many states have statutes of limitations that tend to reduce the number of compensation claims allowed. The term "last injurious exposure" is used in some state statutes to assess responsibility in cases where a man received exposure while working for several employers. Possible interpretations and problems are given in applying this term to compensation cases. (auth)

24665 DEVELOPMENT OF AN OCCUPATIONAL EXPOSURE RECORD SYSTEM TO SUPPORT ADVANCEMENT OF INTERNAL EXPOSURE EVALUATION TECHNOLOGY. Selby, J. M.; Held, K. R. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Monogr. Nucl. Med. Biol., No. 2, 650-3(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

With the growth of the nuclear industry, personnel protection methods and programs have become more sophisticated technically, more standardized in practice and more generally required by government contractors. There are at least 50 handbooks, reports, codes, or regulations, that an employer may be required to use or may find applicable in establishing a radiation protection program suitable to his needs. While many of these require or suggest the retention of occupational exposure records, very few provide clear statements of the purposes to be served by such records, or useful guidance as to the scope, detail, and accuracy, that are required. Hundreds of cubic feet of "occupational exposure records" have been accumulated at Atomic Energy installations for possible legal application and/or technical purposes since the start of the industry. Although useful data may be available from these existing records, in general, the occupational exposure records systems were not designed to support advancement of internal exposure evaluation technology. With higher standards of detail and accuracy than are now generally required, as exposure system covering a large number of employees and a complex array of exposure situations could be made to serve the additional purpose of providing data for improving the understanding of the relationship between the exposure levels or situations and the resultant internal deposition of radioactive materials. (auth)

24666 THE ATOMIC ENERGY COMMISSION'S PROPOSED RECORD KEEPING SYSTEM FOR RADIATION WORKERS. Eason, C. F.; Little, A. O. (Atomic Energy Commission, Washington, D. C.). Monogr. Nucl. Med. Biol., No. 2, 654-60(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

It ought to be enough, in the development of a record-keeping system, if the evidence shows a sufficient connection between

disease and employment to the extent employment may reasonably be identified as a relevant factor. The technical requirements to be met in the handling of evidence in the delayed injury situation, while imposing larger responsibilities on both the lawyer and the radiation expert, ought not to be used to defeat the basic desirability of compensation for an injury, particularly for those least able to bear financially the burden of disabling disease. It is unfortunate that the needs of the radiation worker are tied to a continuing controversy over the necessity for absolute standards, infallible instruments and uncontrovertible analysis. The fact is that we must be concerned with "balancing the risks" and understanding the extent to which socio-economic and political factors influence the shaping of our legal and scientific policies. Too often the experts in the fields of law and radiation have confused the requirements of the law-science dichotomy. The lawyer has been impatient with the scientist's concern for absolute credibility in the development of standards and guidelines. The scientist, correspondingly, lacks appreciation for the flexible character of the law and the influence of public policy on legal developments. The prospective growth of the nuclear industry would appear to justify revitalized efforts by all interested parties to meet a need shared jointly by our workers and the public in terms of adequate safety standards and procedures and adequate compensation provisions. (auth)

24667 PLUTONIUM REGISTRY. Bruner, H. D. (Atomic Energy Commission, Washington, D. C.). Monogr. Nucl. Med. Biol., No. 2, 661-5(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

There is needed a system or device for ensuring that the details of a plutonium contaminating event can be correlated with the worker's subsequent health record. In this way the idea of a Plutonium Registry came into being. Although the primary purpose of the Registry has remained unchanged, there were some additions that briefly are: The Registry should include cases contaminated by any transuranic element. The Registry should not be regarded as a passive receptacle for data fed it by the contributing local health groups. It must also have a well-developed feedback function to those who provide its data. The Registry should not be authoritative in all matters pertaining to plutonium toxicity. The primary responsibility with respect to reporting accidents, case histories, methods of treatment, etc., must remain with the originating local health groups. The medical services of the contractor must undertake an educational program, explaining the objectives and the reasons for the Registry, pointing out that knowledge derived from men exposed under the actual conditions of work is far superior to the extrapolations from the comparatively high dose animal experiments. The Registry must provide information essential for proper legal consideration of the problems growing out of the exposures that may occur from working with plutonium. It is particularly necessary to build into the Registry all useful sources of control data. There was considerable discussion as to what items of information should be collected for inclusion in a person's dossier for the Registry. On the one hand, there was the feeling that a selected minimal number of data should be included, but that these bits should be on every record without exceptions. On the other hand, there was the belief that all possible data that might pertain to the case should be reported; thus, because we can't predict the future, nothing of value for future statistical treatment should be omitted. There was complete agreement, however, that the reporting should be regular and complete, regardless of the protocol decided upon. (E.R.B.)

24668 CALCULATIONS OF DEPTH-DOSE CURVES FOR HIGH-ENERGY NEUTRONS AND PROTONS AND THEIR INTERPRETATION FOR RADIATION PROTECTION. Snyder, W. S.; Wright, H. A.; Turner, J. E.; Neufeld, Jacob (Oak Ridge National Lab., Tenn.). Nucl. Appl., 6: 336-43(Apr. 1969).

Calculated depth-dose curves for protons and neutrons in the energy range 400 to 2000 MeV normally incident on a tissue-equivalent slab were compared with experimental values. The significance of these results for practical problems of radiation protection is discussed. In this energy range, a dose equivalent of 2×10^{-7} rem/fluence seemed adequate for most exposure situations. (auth)

24669 ATOMIC PROTECTION IN AGRICULTURAL PRODUCTION AND THE FOOD INDUSTRY. Minder, Walter (Eidgenoessisches Gesundheitsamt, Bern). Agrarpolit. Rev., 23: 383-6(May 1967). (In German).

The potential of atomic weapon explosions and nuclear power installations to produce radioactive fallout are described briefly. The significance of contamination of soil with ^{131}I is discussed and related to its uptake by grass, cattle, and humans. Hazards from incorporation of ingested ^{131}I by the thyroid gland in children, and methods of removing ^{131}I from milk are discussed. Protective measures, including sheltering of animals, of stored grains and fodder, and of equipment, protective clothing, fallout decay, etc., are described briefly. Prevention of foodstuff contamination by fallout, cleaning of foods after contamination, and similar measures to be taken in event of nuclear disaster are outlined briefly. (BBB)

24670 BEHAVIOR OF DOMESTIC FUNGUS TYPES IN RELATION TO THE FISSION PRODUCT ^{137}Cs. Grueter, H. (Univ., Muenster, Ger.). Z. Lebensm.-Untersuch. Forsch., 134(3): 173-9(1967). (In German).

Concentrations of ^{137}Cs in various domestic types of fungi of Germany are reported. The uptake depended on the type of soil where the fungi grew. In sandy soils uptake was higher than where the fungi grew in heavier forest soils. The decreases in ^{137}Cs concentrations observed over time differed from the radioactive decay of fallout and also from the decreases previously observed in human tissues. The ^{137}Cs concentrations in the fungi were essentially proportional to the soil concentrations. In fungi from forested areas, the ^{137}Cs in the fungi seemed to be proportional to the amounts of ^{137}Cs elutable from pine needles scattered on the floor of the forest. There was no direct relation between the ^{137}Cs/K ratios of the fungi and of the nutrient soil, but there was a relative increase in the ^{137}Cs/K ratio of the fungi. The absolute accumulation of ^{137}Cs by the fungi was as high as 16.5 times the amounts in the soils. In the samples studied there were 1830 pCi of ^{137}Cs/100 g fresh wt. In general, fungi from forest soils covered with pine needles accumulated the most ^{137}Cs, as compared to fungi from other types of wooded areas, or from meadowlands. In elution tests made with Paxillus involutus 64% of the ^{137}Cs was extractable into the cooking water. It was not considered that fungi contaminated with ^{137}Cs would be a radioactive hazard when used as a foodstuff. In order to reach a maximal value of 1600 nCi of ^{137}Cs/yr each adult person would have to consume about 100 Kg of fresh fungi annually, with an average ^{137}Cs concentration of 15 nCi/Kg fresh wt. (BBB)

24671 GUIDANCE IN THE RADIOACTIVITY SURVEY FOR NUCLEAR WARSHIPS. Genshiryoku Iinkai Geppo, 13: No. 10, 7-10(Oct. 1968). (In Japanese).

In order to ensure the safety of a populace at the port-call of nuclear warships, the Government must take all necessary measures. The procedure of radioactivity measurements in this connection, to be observed by the associated agencies etc., is given on the following: organization of the radioactivity survey (purpose, grouping of the measuring teams, the associated agencies and the measuring instruments, training of the personnel); the measurements to be executed (routine measurements, measurements during the access-to-port period, measurements at the port-call, steps to be taken when abnormalities were detected, radioactivity analyses); and reports and announcements. (NSA of Japan)

24672 CALCULATED ENERGY DEPOSITS FROM THE DECAY OF TRITIUM AND OTHER RADIOISOTOPES INCORPORATED INTO BACTERIA. Bockrath, Richard; Person, Stanley; Funk, Fred (Indiana Univ. Medical Center, Indianapolis). Biophys. J., 8: 1027-36(Sept. 1968).

A computer program was written to determine the radiation dose distributions expected within a bacterium as a result of tritium decay, when the isotope is incorporated into specific regions of the bacterium. Energy distributions in the model bacterium were also calculated for the decay of incorporated ^{14}C, ^{35}S, and ^{32}P. A nonspherical model bacterium was used, represented by a cylinder with hemispherical ends. The energy distributions resulting from a wide variety of simulated labeled regions were determined. The results suggested that the nuclear region of a bacterium receives on the average significantly different per-decay doses, if the labeled regions were those conceivably produced by the incorporation of thymidine-^{3}H, uracil-^{3}H, or ^{3}H-amino acids. The killing efficiencies for the different tritium compounds corresponded to mean lethal numbers of decays/bacterium of: 75 for thymidine-^{3}H, 95 for uracil-^{3}H, and 137 for ^{3}H-amino acids. Calculations for the more energetic β emitters ^{14}C, ^{35}S, and ^{32}P also showed differential dose rates, but the amount of energy deposited in the bacterium/decay is considerably less than that from tritium. (BBB)

24673 ESTIMATES OF GONAD AND GENETICALLY SIGNIFICANT DOSE TO THE UNITED STATES POPULATION FROM DIAGNOSTIC ROENTGENOLOGY. Brown, Morton L.; Roney, Paul L.; Hilberg, A. W. (National Center for Radiological Health, Rockville, Md.). Amer. J. Public Health, 58: 2267-74(Dec. 1968).

Estimates based on the 1964 study of the kinds and amount of exposure received by the population of the United States from

medical and dental x rays are presented. Sources of radiation are discussed, and the importance of beam collimation in reducing the genetic dose is emphasized. The estimate for the United States population during 1964 was 55 mrad/person/yr, compared with the 120 mrad/person/yr now estimated to result from natural background radiation and with the 3 mrad/yr estimated from fallout in 1964. This value is compared with similar data for other nations. The value for the United States was higher than that found in most other countries. Genetic dose reflected differences in the age distribution of persons examined, care with which examinations may be performed, and types of examinations. Radiologic examinations of various types were not equally productive of gonad dose and examinations of persons at ages over 35 contributed relatively little to the genetically significant dose. Other factors were the level of fertility, differences in study time period, the number of films/examination, and differences in methodology, particularly dosimetry. The distribution of the genetically significant dose by sex, and by general type of x-ray procedure was summarized. Of the total, 82% resulted from examinations of males, ~16% from examinations of females, and only 2% from exposure of the fetus. Radiography contributed 96% of the total genetically significant dose. Fluoroscopy accounted for only 4% and photofluorography for less than 1%. The dose from dental examinations was negligible. Gonad doses tended to be lowest in hospitals and highest in private physicians' offices. It was estimated that the genetic dose could be reduced by ⅔ if all x-ray beams were collimated to the size of the film used. (BBB)

24674 THE USE OF IONIZING RADIATION IN FLORIDA. Williams, Edwin G.; Harris, Thomas W. S. Med. J., 62: 54-6 (Jan. 1969).

The uses of ionizing radiation in Florida and the public health programs related to them are described and discussed. The activities of the Florida State Board of Health include promulgation of regulations governing the use of ionizing radiation. It has made use of fluoroscopes for shoe fitting illegal; set up a statewide surveillance system for air, water, and milk; instituted a survey of x-ray machines and all radioactive materials, established a program for registration of x-ray machines and licensing of radioactive materials, developed a statewide emergency network to handle possible radiologic emergencies, and assumed protection control in 1964 of certain radioactive materials previously controlled by the U. S. Atomic Energy Commission. Present programs involving radiation include occupational exposure and environmental effects of atomic power, nondestructive testing, process control, and industrial research and development, academic but nonmedical research, development, and teaching, and medical programs in diagnosis, therapy, research, development, and teaching. Baseline environmental studies are conducted to establish reference points as basis for future studies of nuclear power facilities. The number of licenses has increased to 489 and ~20% are for industrial uses. Industrial use of ionizing radiation has increased by a factor of ~10 since 1964. (BBB)

Medicine

Refer also to abstracts 24443, 24512, 24590, 24656, 24660, 24734, 24750, 24753, 24754, and 24759–24762.

24675 (AERE-Trans-1101) INDICATION ASSESSMENT AND DOSIMETRY IN ENDOLYMPHATIC THERAPY USING ^{131}I-LIPIODOL. zum Winkel, K.; Becker, J.; Jahns, E.; Scheurlen, H.; Herzfeld, U. Translated for O. S. Whitston for Atomic Energy Research Establishment, Harwell, Eng., from Strahlentherapie, 133: 481-98(1967). 19p. Dep. CFSTI. UK 4s.

The results of endolymphatic ^{131}I-Lipiodol therapy applied in 45 cases (47 treatments) are discussed. Lymph node scanning was used for the selection of the cases. The activity applied was 2×10 mCi ^{131}I-Lipiodol. Metabolism and storage of the radio-Lipiodol was studied using whole-body counters, scanning and lymphadenography. The effective half-life was different in the lymphatic system, lungs and thyroid. The uptake of Lipiodol by these organs also differed. In some cases a high radiation dose was absorbed by the lymphatic system, but affected lymph nodes often either failed to absorb any Lipiodol or showed insufficient absorption of contrast material. In such cases, or in delayed regression of enlarged lymphomas, after-treatment by external radiation is indicated. Endolymphatic radio-Lipiodol therapy is a useful adjuvant, but not yet a substitute for tried and tested radiotherapies. (auth)

24676 (CONF-670649-4) STUDY OF THE PARASTERNAL LYMPHATIC GANGLIA BY MEANS OF GAMMAGRAPHY AND SUBCUTANEOUS INJECTION OF IODIC CONTRASTS. Ortiz Berrocal, J.; Marcos Lopez, J.; Gomez Lavin, P.; Arnaiz Bueno, F. (Clinica Puerta de Hierro, Madrid (Spain)). [1966]. 5p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

A technique for the visualization of parasternal, subclavical, and axiliary lymphatic ganglia is described. It uses the subcutaneous injection of a solution of radioactive colloidal gold (^{198}Au) and is based on the lymphatic transport of subcutaneous injections. The principles and techniques of the method are given. The results obtained on normal subjects, patients with metastasic invasions, and patients with systemic illnesses of the lymphatic ganglia are reported. The technique is evaluated. (tr-auth)

24677 (CONF-670649-16) MORPHOLOGICAL DEMONSTRATION OF THE SPLEEN AND KIDNEYS WITH ACETO-MERCURI-HYDROXYPROPANE LABELED WITH ^{197}Hg (AMHP-^{197}Hg). Crespo Diez, A.; Arnaiz Bueno, F.; Ortiz Berrocal, J. (Clinica Puerta de Hierro, Madrid (Spain)). [1967]. 13p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The preliminary results obtained with the use of accto-mercurihydroxypropane (AMHP)-^{197}Hg for the morphological study of the spleen and kidneys are presented. The method was applied to normal subjects and to patients afflicted with illnesses localized in the spleen. The distribution of the activity after the injection of the labeled compound, the incorporation by the spleen, and the accumulation in the spleen and kidneys were determined. (tr-auth)

24678 (TID-3319) NUCLEAR MEDICINE. Bibliography from Nuclear Science Abstracts, Volume 21. Donald, Helen G. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). June 1968. 295p. Dep. CFSTI.

The citations included in this bibliography were taken from Nuclear Science Abstracts, Volume 21. Each item included in the bibliography is represented by its descriptive cataloging (bibliographic citation) and by subject content annotations consisting of: an alphabetized list of all subject index headings assigned to the item and a phrase following each subject heading showing the relation of the subject heading to the item. Nine hundred and ninety-nine items are included under the headings of Treatment of Radiation Sickness, Radiodiagnosis, and Radiotherapy. (E.R.B.)

24679 (UCRL-50007-68-2, pp 51-8) EVALUATION OF X-RAY FLUORESCENCE FOR IN VIVO BIOLOGICAL STUDIES. Tinney, J. F.; Cate, J. L. (California Univ., Livermore. Lawrence Radiation Lab.).

Some preliminary results are reported in a research program to theoretically and experimentally determine the feasibility of using fluorescent x rays for in vivo biological studies. (auth)

24680 INFLUENCE OF EXTIRPATION OF THE ADRENALS AND ADMINISTRATION OF HORMONE PREPARATIONS TO INTACT AND EPINEPHRECTOMIZED ANIMALS ON RADIATION CHANGES IN THE PERIMURAL DIGESTION. Bulbuk, G. A. (Central Roentgenoradiological Scientific Research Inst., Leningrad). Radiobiologiya, 9: No. 1, 69-74(1969). (In Russian).

The influence of extirpation of the adrenals and the injection of hormone preparations of the type of gluco- and mineral corticoids on radiation disruption and restoration of perimural hydrolysis of sucrose and processes of enzyme formation in the upper and lower divisions of the small intestines was studied in experiments on noninbred female white rats. It was established that preliminary removal of the adrenals leads to a decrease in the degree of radiation damage to the investigated functions of the small intestine. However, restoration of the hydrolytic processes in the intestines, impaired by irradiation, is greatly suppressed in the adrenalectomized animals. Hydrocortisone aggravates the degree of radiation damage and inhibits recovery, while corticosterone, deoxyacetate, on the contrary, has a protective effect. (JPRS)

24681 EFFECTS OF RADIOPROTECTORS UNDER CONDITIONS OF FRACTIONATED IRRADIATION. COMMUNICATION 6. PROTECTION FROM CHROMOSOME DAMAGES AT LOW DOSES OF IRRADIATION. Ol'shevskaya, O. P.; Yarmonenko, S. P. (Inst. of Labor Hygiene and Occupational Diseases, Moscow). Radiobiologiya, 9: No. 1, 58-61(1969). (In Russian).

The use of 5-methoxytryptamine hydrochloride (mexamine, 15 mg/kg, intraperitoneally) directly before irradiation of rats at a dose of 300 R or before each irradiation in the case of daily influences at doses of 10, 25, and 30 R up to the same total dose of 300 R, produced a decrease in the number of liver cells with chromosome aberrations, detectable in the regenerating organ. The degree of protective effect within the dose range studied did not depend on the size of the dose and conditions of irradiation. The coefficients of protection in the case of single and fractionated irradiation were 0.52 and 0.57, respectively. The protective effect of cystaphos (sodium 2-aminoethylthiophosphate, 250 mg/kg) under

the same experimental conditions proved to be substantially smaller according to the criterion used. The coefficients of protection were equal to 0.24 for a single irradiation and 0.35 for fractionated irradiation. (JPRS)

24682 PROCEEDINGS OF THE 7th ANNUAL MEETING OF THE JAPANESE SOCIETY OF NUCLEAR MEDICINE, NOV. 17, 18, 1967, TOKYO, JAPAN. VOLUME 7. Jap. Nucl. Med. (Proc.), 7: 1-170(Oct. 1968). (CONF-671113).

Abstracts of the papers presented at the seventh annual meeting of the Japanese Society of Nuclear Medicine (1967) are presented. The general theme of the papers was the use of radioisotope scanning techniques in diagnostic procedures. The abstracts are arranged according to the organ or tissues involved. (E.R.B.)

24683 RADIOLOGICAL, AUTORADIOGRAPHICAL, AND SCINTIGRAPHICAL FINDINGS IN NECROSIS OF THE FEMUR HEAD. Bessler, W. (Kantonhospital, Winterthur, Switzerland). Fortschr. Geb. Roentgenstr. Nuklearmed., 110: 214-23(Feb. 1969). (In German).

Radiological, autoradiographic, and scintigraphic examinations indicate that there is an increased blood flow and osteogenesis in the femoral head in most cases of femoral head necrosis. This is evidently the reaction of living bone to ischaemic foci within it. The increased radioactivity indicated by autoradiography and scintigraphy indicates the intensity of the pathologically increased bone remodeling. Scintigraphy provides information regarding the prognosis and the choice of treatment as well as the result of any previous operations. (auth)

24684 EXPERIENCE IN INFILTRATING BRAIN TUMORS TREATED STEREOTACTICALLY BY INTERSTITIAL BRACHYTHERAPY WITH ^{192}Ir "GAMMAMED". Mundinger, F. (Univ., Freiburg i. B.). Fortschr. Geb. Roentgenstr. Nuklearmed., 110: 254-61(Feb. 1969). (In German).

Experience with post-operative interstitial brachytherapy, with ^{192}Ir in malignant tumors of the brain, is described. For this purpose, he used a contact irradiation device, the "GammaMED" constructed in conjunction with Sauerwein. Localization of the cannula in the centre of the cerebral tumor can be achieved with an accuracy of 1 mm. using the stereotactic apparatus of Richert and Mundinger. It is possible to obtain continuous tiny pieces of tissue for rapid histological examination (Metzel) and for determination of the tumour volume. 103 courses of irradiation were given to 77 patients and the results in 64 patients were evaluated (31. 12. 1968). 70% are still alive, with significantly longer survival than our previous series of interstitial irradiation (e.g., glyoblastomas up to 49 months, malignant astrocytomas up to 38 months). Of 22 subsequent operations, radiation necrosis only, without any tumor tissue, was found in nine patients. (auth)

24685 SIMPLE PROCEDURE TO PRODUCE ^{99m}Tc SULFUR-COLLOID FOR LIVER SCANNING. Akhtar, M. (Univ., Bonn). Fortschr. Geb. Roentgenstr. Nuklearmed., 110: 271-5(Feb. 1969). (In German).

A method for the preparation of ^{99m}Tc-antimony-sulphur colloid for hepatic scintigraphy is described. The properties of this substance are enumerated. The possibility of side effects is discussed. The usefulness of the colloidal substance has been proved by means of animal experiments and by its clinical application for a period of two years. (auth)

24686 KINETICS OF ^{131}I-ROSE BENGAL IN THE DIFFERENTIAL DIAGNOSIS OF CIRRHOSIS AND BILIARY TRACT OBSTRUCTIONS. Cravario, A.; De Filippi, P. G.; Molino, G. (Univ., Turin). Boll. Soc. Ital. Biol. Sper., 44: 1498-1501 (Sept. 30, 1968). (In Italian).

A model of the kinetics of Rose Bengal was constructed by determining simultaneously the conventional hepatogram and the hematic kinetics of the dye by means of a counter at the level of the temporal region. The model constructed was applied to normal cases, cirrhotic patients, and patients with biliary tract obstructions. A comparison of the results obtained, with the plasma decay constant, K obtained with bromosulfonaphthaline, shows some correspondence between the two methods, but the correlation between the major parameter of the model and K is not significant. (J.S.R.)

24687 BERYLLIUM DISEASE: A 16-YEAR FOLLOW-UP CASE STUDY. Redding, Ralph A.; Hardy, Harriet L.; Gaensler, Edward A. (Boston Univ.). Respiration, 25: 263-78(1968).

The Beryllium Case Registry, supported by the Atomic Energy Commission, was begun in 1952 and by June 1966 contained 760 cases, including 498 of the chronic form. A case of chronic Be poisoning was presented in which the disease resulted from work with x-ray tube windows 27 years ago, and which was confirmed by lung biopsy 11 yr later. Detailed physiological studies were obtained before treatment and at regular intervals during the 16 yr that the patient received corticosteroids. The manufacture, uses, and toxicology of Be were discussed, and the history of clinical and pathologic observations were described. Since the absorption of x rays by Be was 1/17th that of Al, it was preferred for x-ray tube windows. The pure metal was used in the nuclear energy field as a source of neutrons which were emitted following bombardment by α rays. The oxide of beryllium has a high melting-point, great strength and hardness, large electrical resistance, good thermal conductivity, and chemical inertness. Therefore, it serves as refractory support for electrical heaters, as thermal radiation shield for graphite crucibles, and as lining in coreless induction furnaces. Prevention plays a most important role in the control of Be disease. Recommendations on permissible exposure levels by the Atomic Energy Commission in 1948, even though still controversial, have been widely adopted and have proved effective. Uncontrolled exposure is now rare and usually due to ignorance or new uses. (BBB)

24688 APPLICATION OF ACTIVATION ANALYSIS IN BIOLOGY AND MEDICINE. Kasperek, K. (Kernforschungsanlage, Juelich, Ger.). Atomkernenergie, 14: 143-6(Mar.-Apr. 1969). (In German).

A description of activation analysis, activation possibilities with neutrons and γ-ray spectrometrical analysis techniques for the determination of elements in biological samples is presented. Activation analysis is a tool for research and diagnosis, especially for the determination of trace-elements in various biological materials as well as of elements with enriched stable isotopes, applied in diagnosis. For the resorption study a patient receives orally an element which consists of two or more stable isotopes and which is artificially enriched in one suitable isotope (e.g., calcium, enriched with ^{46}Ca). The element is thus clearly marked. After ingestion samples, mainly of blood, but also of urine and other samples are activated. Measurements are then made of the radiation intensity of two suitable γ lines of radioisotopes created out of the stable isotopes, in the samples and in a standard. The quantity of the resorbed isotope and the amount of the resorption of the whole element can be calculated. By using stable marked elements the patient is not subjected to any radiation, it is particularly suitable for pregnant women and children. (auth)

24689 AEA WORK IN MEDICAL ENGINEERING. Atom, No. 150, 100-7(Apr. 1969).

Work in the field of cardiac pacemakers at AERE Harwell and AWRE Aldermaston is described under the following headings: Cardiac pacemaker encapsulation; pacemaker performance under simulated body conditions; characteristics of encapsulating resins; isotope-powered cardiac pacemakers; present status; the isotope battery and dc to ac converter; and safety of the plutonium source. Some brief notes are also given of work on dental materials, semiconductor radiation detectors, automated blood factor VIII equipment, short range radiotelemetry system for patient monitoring, dual viewing attachment for medical endoscopes, dental drills, medical infrared scanner, artery clearance, corrosion of surgical implants, chemical studies of artificial kidneys, gamma camera using solid state detector matrix, and automatic potentiometric titration apparatus. (UK)

24690 ANTITUMORAL AND TOXIC EFFECT OF CYCLOPHOSPHANE AND PREPARATION IF-202 AGAINST THE BACKGROUND OF ANTIRADIATION REMEDY AET (S, β-AMINO ETHYLISOTHIURONIUM). Dauvarte, A. Zh.; Zidermane, A. A. Latv. PSR Zinat. Akad. Vestis, No. 11, 123-31(1968). (In Russian).

Hematopoiesis is protected against radiation damage in rats by AET, which suppresses the effect of cyclophosphane. Separate introduction of AET affects rat hemopoiesis and causes fluctuations of the overall leucocyte and thrombocyte counts. Protection against toxicity of preparation IF-202 is not afforded by AET. (TSS)

24691 THE COMBINED EFFECT OF 6-AZAURIDINE AND IRRADIATION IN VIVO AND IN VITRO. II. THE NUCLEIC ACID LEVEL IN THE EHRLICH ASCITIC CARCINOMA CELLS AFTER REPEATED APPLICATIONS OF 6-AzUR AND IRRADIATION IN VITRO. Grozdanovic, J.; Vich, Z.; Truxova, G. (Health Inst. of Uranium Industry, Pribram, Czech.). Neoplasma, 15: 685-7 (1968).

The repeated irradiation of Ehrlich ascitic carcinoma cells in vitro (10 times 300 R in 18 weeks) caused the successive increase of DNA level. The same effect was observed after irradiation and following application of 6-AzUR. The application of 6-AzUR before irradiation prevented the increase of DNA content. It was assumed that the presence of 6-AzUR during irradiation decreased the radiation effect by the mechanism that has not been successfully explained yet. (auth)

24692 CONTRIBUTION TO X-RAY DIAGNOSIS OF CYLINDROMAS OF THE SUPERIOR MAXILLA REGION. Canigiani, G. (Univ., Vienna). Fortschr. Geb. Roentgenstr. Nuklearmed., 109: 752-8(Dec. 1968). (In German).

Thirty cylindromhs were observed over a period of several years; the characteristic radiological appearances and the course of this disease are reported. Four cases were selected to show the characteristic clinical course and appearances. If radiological examination raised a suspicion of the presence of a cylindroma, it was absolutely necessary to confirm the diagnosis histologically. Suitable treatment depended on the extent of the changes demonstrated clinically and radiologically. Treatment in the first place was operative, since cylindromas tend to be radiation resistant, and in most cases, even high doses result only in a slowing dose of growth. (auth)

24693 SOME THEORETICAL AND PRACTICAL PROBLEMS OF RESEARCH ON PHARMACOLOGICAL RADIATION PROTECTION. Sztanyik, Laszlo; Santha, Andras. Honvedorvos, 20: 348-65(Oct.-Dec. 1968). (In Hungarian).

On the basis of literature data and direct experiences gained in more than a decade of research, the experimental conditions are analyzed which must be standardized to enable the comparison of results achieved at different laboratories and institutes in the course of experimental study of radioprotective compounds. The role of experimental animals, their maintenance conditions, the circumstances of irradiation and the dose of radiation administered are discussed in detail. The criteria of radioprotective effect are defined and a more exact definition of the indexes used for evaluation of the compounds is recommended. Furthermore, the extrapolation possibilities from animal experimental data to humans are analyzed. The similarities and differences present between conditions of animal experiments and of clinical application are pointed out. In conclusion, the more important cautions to be observed when clinical pharmacological methods are used for the testing of radioprotective compounds on humans are pointed out. (JPRS)

24694 PROTECTION OF THYROID GLAND AND TOTAL BODY FROM RADIATION DELIVERED BY RADIOACTIVE IODINE. Tanaka, S.; Mochizuki, Y.; Yabumoto, E.; Iinuma, T. A.; Kumatori, T.; Yamane, T.; Akiyama, T.; Matsusaka, N. (National Inst. of Radiological Sciences, Chiba, Japan). Monogr. Nucl. Med. Biol., No. 2, 298-314(1968).

From Symposium on Diagnosis and Treatment of Deposited Radionuclides, Richland, Wash. See CONF-670521.

Radioactive iodine is one of the most important fission products of uranium or plutonium from the viewpoint of Health Physics. Once the radioiodine is released into the human environment, it is easily absorbed into the body through the respiratory organ, gastrointestinal tract and to some degree through the skin. Radioiodine concentrated in the thyroid gland, could be the primary cause of some hazards, such as thyroid nodules, hypothyroidism, growth retardation and probably the development of cancer. In the case of a massive release of radioiodine, the radioiodine easily enters into the body and some suitable prophylactic or therapeutic measures are necessary for reducing the dose of radioiodine in the thyroid gland and extra-thyroidal tissues. The effects of stable iodide and several anti-thyroid drugs on an accumulation of radioiodine in the thyroid gland and on the retention in the extra-thyroidal tissues were investigated in the adult, fetal, and new-born rats and in humans, in an attempt to protect them from the radiation hazards of radioiodine. (E.R.B.)

24695 NEUTRON ACTIVATION ANALYSIS FOR THE EARLY DIAGNOSIS OF CYSTIC FIBROSIS. Woodruff, G. L.; Babb, A. L.; Wilson, W. E. Jr.; Yamamoto, Yuki; Stamm, S. J. (Univ. of Washington, Seattle). Nucl. Appl., 6: 352-9(Apr. 1969).

A technique using neutron activation analysis was developed for the early diagnosis of cystic fibrosis in children and infants. Toe and finger nail clippings from infants (under one month of age) and children (under 12 yrs of age) were collected in a prescribed manner and neutron-irradiated in a reactor. The irradiated samples were analyzed for Na, K, and Cl concentrations, and the patients having abnormally high values of Na and Cl were detected by computer sorting. (auth)

24696 EXPERIENCE IN THE SURGICAL TREATMENT OF RADIATION DAMAGE TO THE SKIN. Shevyakov, V. V. (Kharkov Scientific-Research Inst. for Medical Radiology). Vestn. Khir., 100: 95-7(Feb. 1968). (In Russian).

An analysis of the results of surgical treatment in 80 patients with radiation skin injuries of various localization is presented. In all patients radical excision of radiation ulcers within the boundaries of intact tissues was performed with subsequent skin plasty. After surgical therapy no recurrence was observed. (auth)

24697 REPAIR OF RADIATION-DAMAGED SKIN DEFECTS IN THE FACE AND NECK REGION. Mennig, H. (Univ., Berlin). Hautarzt, 18: 264-8(June 1967). (In German).

The repair, prognosis, and results obtained following treatment of radioinduced skin defects in the face and neck area were discussed. It was found that radiation-damaged areas where a carcinoma might develop should be excised well into healthy areas, but not repaired immediately, so that evidence of tumor recurrence could be more easily observed, especially in aged, weakened patients. For optimum healing and cosmetic results the best procedures in descending order of preference were skin grafts, sutured flaps, and rotated flaps. Use of skin grafts was limited by the oncological and prognostic aspects of the radiation-damaged area. Compound flaps were more suitable than split flaps, but healed less readily. Sutured flaps produced poor cosmetic results, because the skin around the radiation skin injury was usually damaged and the flap had to be retained by healthy skin relatively distant from the injured site. Radiation-damaged skin could be used as an internal lining for penetrating defects, because healing was protracted. The best repair procedure was use of circular pedicle flaps, but these were not always suitable for patients. Soft, elastic epitheses were used for repair of radiation-damaged skin whenever feasible. (BBB)

24698 DOES JUDOLOR AFFECT TUMOR CELLS. Ruether, Walter (Institut fuer Strahlenbiologie und Medizinische Isotopenanwendung, Marburg, Ger.). Muenchen. Med. Wochenschr., 110: 431(Feb. 16, 1968). (In German).

The question of whether Judolor, or thiamine tetrahydrofurfuryldisulfide (TTFD), affects kinetic mechanisms of tumor cells was raised and discussed. Animal studies with substances that are known to have radiation protection properties, such as cysteine, cysteamine, aminoethylisothiuronium, and serotonin have not demonstrated generally useful or consistent results. Most studies have shown that few chemical substances have radioprotective actions, and do not alter kinetic factors in tumor cells. When x-irradiated patients were treated with TTFD nausea, vomiting, and other postirradiation symptoms were decreased. In addition, leucocyte counts were increased by TTFD treatment. However, the question whether TTFD also affected the kinetic mechanisms of the tumor cells themselves in these patients was not resolved by this study. (BBB)

24699 THIRD SYMPOSIUM ON ADVANCED MEDICINE. Proceedings of a Conference held at London, 13th February–17th February, 1967. Dawson, A. M. (ed.). Baltimore, Williams and Wilkins Company, 1968. 451p. $9.00. (CONF-670221).

One paper from this symposium was abstracted for NSA. This one was from the section on environmental medicine. Other sections included opportunist infections, tropical disorders, arrythmias, metabolic disorders, alcoholism, skin diseases, and hematology. (C.O.)

For abstract of individual papers see: 24758.

24700 INFLUENCE OF PRIOR INTESTINAL RESECTION ON SURVIVAL TIME OF INTESTINE-IRRADIATED RATS. Sigdestad, C. P.; Osborne, J. W.; Levine, D. L. (Univ. of Iowa, Iowa City). Int. J. Radiat. Biol., 15: 65-73(1969).

The effect of resecting 70 percent of combined ileum and jejunum on the survival time of rats subjected to x irradiation of the remaining ileum and jejunum was studied. The variables tested were interval between irradiation and operation (7, 15, 30, 60 days) and magnitude of exposure to the exteriorized gut (1500, 2000, 2500, 3000 and 3500 R). The resected animals were less sensitive to irradiation than were sham-resected animals. The survival time was enhanced by increasing the time between surgery and irradiation, and was decreased by increasing the exposure. Possible mechanisms are discussed. (auth)

24701 RECENT CONCEPTS OF TIME-DOSE-VOLUME RELATIONSHIPS. Von Essen, Carl F. (Yale Univ., New Haven). Indian J. Radiol., 20: 208-13(Nov. 1966).

Recent concepts underlying use of irradiation therapy are reviewed. The repopulation hypothesis and its relations to time-dose-volume are discussed. A 3-dimensional model that describes the relations of tumor curability and normal tissue tolerance to cumulative irradiation dosage, overall time, and irradiated area is illustrated. The isoeffect planes for normal tissue tolerance and tumor curability diverge in the direction of increasing overall time (positive therapeutic margin) and converge in the direction of increasing irradiated area or volume (negative therapeutic margin). The repopulation hypothesis is used to explain these relations. As overall time increases, the cumulative dosage must increase for both normal and malignant

tissue because of recovery of sublethal injury. The divergence of the slopes reflects the amount of repopulation of normal tissues as a function of time. As area or volume increases, the rate and amount of repopulation diminishes, resulting in a decreasing tolerance dosage, while the tumor lethal dose must increase because of the larger number of cells requiring sterilization. The significance of these factors to supervoltage techniques is discussed. (BBB)

24702 TRANSPORT OF INTRATHECAL ^{125}I-RISA TO CIRCULATING PLASMA: A TEST FOR COMMUNICATING HYDROCEPHALUS. Abbott, Michael (Univ. of California, Los Angeles); Alksne, John F. Neurology, 18: 870-4(Sept. 1968).

A radioisotope method was developed for diagnosis of hydrocephalus by studies in dogs. Use of ^{131}I- vs ^{125}I-labeled serum albumin (RISA) and the comparative radiation hazards are considered. In dogs, following the intracisternal injection of 25 μCi of ^{131}I RISA, ~45% of the radioactivity was present in the circulating plasma 16 to 24 hr after ^{131}I administration. With the dose used the blood level of radioactivity was adequate for significant counting. The amount of radioactivity in the required dose of ^{131}I was excessive. To minimize this radiation hazard, ^{125}I-RISA was used as a tracer. The ^{125}I has a 60-day half life in contrast to the 8-day half life of ^{131}I. As a result, most of the material was excreted before it decayed. More important from a standpoint of safety was the fact that the ^{125}I isotope was a pure γ emitter, which lacked the dangerous β emission found with ^{131}I. Because of these factors, ^{125}I was considered four times safer than ^{131}I. Dose ranges could therefore be employed which allowed easy measurement of the isotope in peripheral blood after cerebrospinal fluid (CSF) injection and still be safe for the recipient. It was shown that both experimental and clinical hydrocephalus can be differentiated from the normal state of CSF dynamics using the transport of intrathecally introduced ^{125}I-RISA to the circulating plasma. From 37 to 60% of the injected RISA was found in the plasma 24 hr after administration in normal subjects. In hydrocephalus from 10 to 33% of the injected RISA was found circulating at 24 hr. (BBB)

24703 CARCINOMA OF THE ESOPHAGUS IN INDIA. Desai, P. B.; Borges, E. J.; Vohra, V. G.; Paymaster, J. C. (Tata Memorial Hospital, Bombay). Cancer, 23: 979-89 (Apr. 1969).

It is as yet an unrecognized fact in geographic pathology that cancer of the esophagus has the highest incidence in India. Fifty-one percent of cases are too advanced for any treatment at their initial presentation. The management of cancers of the upper third, the middle third, and the lower third of the esophagus (excluding the cervical esophagus) is discussed. Cancers of the middle segment are the most common and the most debated as regards management. Results of radiotherapy and surgery are presented and compared. Where radiotherapy failed, it is believed that a group of patients could have been salvaged by timely excision of their growths. Thus, radiotherapy and surgery should have a complementary role in the overall management. Preliminary ideas on the value of preoperative irradiation are presented. The ideal method of preoperative irradiation and the ideal surgical approach are still matters of debate and uncertainty. Although the overall prognosis of a patient with esophageal cancer still remains poor, earlier diagnosis, the advent of supervo.tage therapy, careful surgery and cautious chemotherapy at the optimum time may help to bring the ultimate survival rate of esophageal cancer patients close to that of patients with other malignancies. (auth)

24704 ESTIMATION OF ABILITY OF CHEMICAL RADIOPROTECTOR AGAINST LEUKOPENIA DURING RADIATION THERAPY. Ueno, Yori (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 1337-40(Jan. 1969). (In Japanese).

For an estimation of the efficiency of chemical protectors against radiation injury in radiation clinics, a new method using the degree of leukopenia and accumulated tumor dose was presented and was described as the LRR (Leukocyte reduction rate) method by the author. The LRR was presented as follows: LRR = (A−B/A)/D where A was the peripheral leukocyte count before radiation therapy, B was the minimum value of peripheral leukocyte count during radiation therapy, and D was the accumulated tumor dose presented with R unit when the peripheral leukocyte count was B. Eighty-eight patients in four radiation clinics were randomly picked to be analyzed according to this method. It was shown from the present results that there were two components with low and high LRR values in the population of patients with leukopenia in radiation therapy, independently from the types of tumors. The ability of protection of synthetic reduced glutathione was estimated quantitatively by an increase in the component with low LRR value. (NSA of Japan)

Radiation Effects on Animals

24705 INFLUENCE OF N-ETHYLMALEIMIDE AND PARACHLOROMERCURYBENZOATE ON THE RADIOSENSITIVITY OF EHRLICH'S ASCITIC CARCINOMA CELLS. Gusareva, E. V.; Nekrasova, I. N.; Tarasenko, A. G.; Graevskii, E. Ya. (Inst. of Developmental Biology, Moscow). Radiobiologiya, 9: No. 1, 52-7(1969). (In Russian).

The radiosensitizing effect of N-ethylmaleimide and parachloromercuribenzoate on Ehrlich's ascites carcinoma cells, irradiated under conditions of anoxia and normal aeration, was investigated. It was established that these substances distinctly sensitize cells to radiation only in the case when the radioresistance of the latter is preliminarily increased by a stay under oxygen-free conditions. These substances, added to the cells before irradiation in air or immediately after irradiation in air or in argon, do not exhibit radiosensitizing activity. It may be assumed that the radiosensitizing effect observed under conditions of anoxia is due to a reduction of the thiol level in the cells. (JPRS)

24706 IN VITRO STUDIES ON THE RADIOSENSITIVITY OF HeLa CELLS ACCORDING TO A NEW METHOD. Balestra, E.; Cavanna, M.; Parodi, S. (Univ., Genoa). Boll. Soc. Ital. Biol. Sper., 44: 1470-2(Sept. 30, 1968). (In Italian).

The radiosensitivity of HeLa cells cultivated in Eagle Basal Medium was measured. The culture was exposed to doses between 132 and 834 R measured in air. The percentage inhibition of growth was calculated after seven days. The results show that the radiation dose inhibiting growth by 50% is 301 R and the 100% lethal dose is 990 R. The HeLa cells are more radioresistant than KB cells cultivated under the same conditions. (J.S.R.)

24707 MAXIMUM LIKELIHOOD ESTIMATION OF SURVIVAL CURVE PARAMETERS. Frome, Edward L.; Beauchamp, John J. (Oak Ridge National Lab., Tenn.). Biometrics, 24: 595-605 (Sept. 1968).

In the quantitative investigation of cytological damage resulting from ionizing radiation, the survival curve is used to establish relations between the radiation dose and the response. Estimates of the parameters of survival curves were obtained with the help of the maximum likelihood principle, to show that equivalent estimates can be obtained with a properly weighted least squares approach, and to propose a procedure for testing the adequacy of the model being used. The estimation procedure is developed under the assumption that the observations are distributed as independent Poisson random variables. In addition, a weighted least squares procedure, which gives estimates equivalent to the maximum likelihood estimates, is presented. Tests of the model and of the assumed distribution of the observations are given. Two illustrative examples are included. It was shown how, by use of the asymptotic normality of maximum likelihood estimators, approximate confidence intervals for the survival curve parameters may be calculated. (BBB)

24708 ON THE INCREASED PRECURSOR INCORPORATION INTO DNA OF IRRADIATED MAMMALIAN CELLS. Smets, L. A. (Euratom Joint Research Centre, Ispra, Italy). Int. J. Radiat. Biol., 14: 585-8(1968).

In human kidney (T) cells the rate of ^{3}H-TdR (tritiated thymidine) incorporation is shown to be depressed at any time after irradiation. The DNA-synthetic S-phase lasts longer than necessary to compensate for this. Monolayer asynchronous cultures in the log phase of growth, grown in supplemented Parker's medium, were exposed to ^{3}H-TdR at 0.5 μCi/ml. Radiation was with unfiltered x rays of 250 kV at 125 R/min. Supporting evidence is given in a table of percentages of cells labeled over and at different times after irradiation, and plots of percent uptake as a function of dose and of time, and of DNA specific activity versus time. The disturbed post-irradiation DNA synthesis is probably due to abnormal DNA metabolism in lethally damaged cells. (C.O.)

24709 A CORRELATION BETWEEN DIVISION DELAY AND LOSS OF COLONY-FORMING ABILITY IN CHINESE HAMSTER CELLS IRRADIATED IN VITRO. Froese, G.; Cormack, D. V. (Manitoba Cancer Treatment and Research Foundation, Winnipeg). Int. J. Radiat. Biol., 14: 589-92(1968).

In order to discover if division delay and loss of colony-forming ability are caused by the same radiation-induced lesion, 2 experiments have been performed. The first, reported as a graph of generation time versus radiation dose, indicates that at between 500 and 800 rads V79 cells producing daughter cells which in turn divide suffer significantly less division delay than those where one or both of the daughters disintegrate. In the second experiment, in order to eliminate cell to cell effects, single cells were trypsinized and placed in sealed, completely filled growth chambers at 37°C,

and irradiated after incubation (nearly all cells doublets) to 500 rads with ^{60}Co γ rays. Results (graph) show statistically significant delays, greater for colony forming cells than for noncolony formers, when compared with unirradiated controls. The results for both experiments suggest that the two effects, division delay and loss of colony-forming ability, are at least partly due to the same lesion, but differently affected by environment. Seemingly they are not due to different probabilities of disintegration and colony-forming ability, respectively, for cells irradiated at various stages in the life cycle. (auth)

24710 COLONY FORMING ABILITY OF X-IRRADIATED HeLa S3 CELLS. Masuda, Kouji (Kyushu Univ., Fukuoka). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 1396-1403(Jan. 1969). (In Japanese).

The colony forming ability of x-irradiated HeLa S3 cells was studied by the single cell culture method. Eagle minimum essential medium (1959), supplemented with 20% calf serum, 50 μg of streptomycin, and 50 units of penicillin per milliliter, was used. Assuming a colony having more than 50 normal cells at the end of incubation developed from a single surviving cell, and applying this assumption at 10, 14, or 18 days after irradiation: The surviving fraction 10 days post irradiation equalled the surviving fraction at 18 days. The average size of surviving colonies 18 days post inoculation exceeded that at 10 days. For abortive colonies, size distributions were equal at 10, 14, or 18 days after inoculation, and no increase in colony number was observed by incubation period, and medium replacement seven days after inoculation did not affect cell reproductive survival. Non-irradiated cells that divided into more than 20 cells 14 days after inoculation continued to multiply and grow. These findings support the criterion for survival that a colony having more than 50 normal cells at the end of 10 to 18 days incubation developed from a single surviving cell. Cell reproductive capacity was depressed by x irradiation. The average size of survival colonies varied inversely with dose. The percentage of abortive colonies per dish—especially isolated giant cell colonies—varied directly with dose. The dose-response curves and survival colony size distributions suggested that the damage that caused delay in division may differ from that which caused loss of cell reproductive capacity. Analysis of abortive colony size distributions by dose, suggested that dose variation resulted in various mechanisms that caused the loss of cell reproductive ability. (NSA of Japan)

Invertebrates

24711 (A-AC.82/G/L-1254, pp 18-23) RADIOECOLOGICAL STUDIES IN THE REGION OF THE MURUROA ATOLL (YUAMOTU ARCHIPELAGO). Kolesnikov, A. N.; Barinov, G. V.; Zesenko, A. Ya. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). (In Russian).

During the 20th trip of the research ship "Michail Lomonosov," measurements were made on the radioactivity of plankton in the area of the Tuamotu Archipelago which lies north from the French Atomic test site at the Mururoa Atoll. The specimens were collected during the period from December 30, 1966 to January 4, 1967, i.e., three months after the explosion of an atomic device. It was found that the biomass of zooplankton in the upper 100-m layer was very low,— 5 mg/m^3, increasing to 12.5 mg/m^3 during the night. Within a small region, closest and to the west from the test site, anomalous specimens of the species Pleuromamma piseki were found. They were carried westward by the prevailing ocean currents. The specimens collected at points 120 and 135 miles from the test site were found 100% anomalous; those collected at a distance of 2000 miles exhibited 20% of anomalies. These anomalies. These anomalies must be attributed to ionizing radiation resulting from the atomic explosion. Many questions, such as whether the changed forms are hereditary, a mutant, and their distribution in time and space are as yet unanswered. (TTT)

24712 ROENTGENOMORPHOSES OF DROSOPHILA MELANOGASTER MACROCHAETA AFTER IRRADIATION OF LARVAE AND PUPAE AT VARIOUS STAGES OF DEVELOPMENT. Gornaeva, G. F. (Inst. of Cytology, Leningrad). Radiobiologiya, 9: No. 1, 151-3(1969). (In Russian).

An investigation was made of the variation of the radiosensitivity of bristle rudiments in larvae of wild-type Canton-S flies after x irradiation at doses of 600, 800, 1000, and 1500 R. The frequency of appearance of roentgenomorphoses increased from 5.3 to 73.4% in the females and from 2.9 to 36.9% among the males. In the case of irradiation of Drosophila melanogaster larvae and pupae at different stages of development, from 24 hrs after egg-laying up to the imago stage, at a dose of 1000 R, a pronounced maximum of morphoses was detected on the fifth day after irradiation of the larvae, which corresponded to the period after pupation. It was concluded that this period in ontogenesis is the critical period of the development of bristles. (JPRS)

24713 REPRODUCING CAPACITY OF GAMMA-IRRADIATED ADULT MALES OF THE CONFUSED FLOUR BEETLE. Vereecke, A. (Faculty of Agricultural Sciences, Ghent). J. Econ. Entomol., 62: 357-9(Apr. 1969).

After treatment with ^{60}Co γ rays, adult Tribolium confusum Jacquelin duVal males were mated with untreated females. Fecundity and fertility were checked for 44 days after treatment. Fecundity was not affected. Fertility was considerably reduced but partially recovered by the end of the experiment. (auth)

24714 EFFECTS OF GAMMA RADIATION ON THE TOBACCO BUDWORM. III. IRRADIATION OF EGGS AND LARVAE. El Sayed, E. I.; Graves, J. B. (Louisiana State Univ., Baton Rouge). J. Econ. Entomol., 62: 296-8(Apr. 1969).

Zero- to one-, one- to two-, and two- to three-day-old eggs and one-, six-, nine-, and 15-day-old larvae of Heliothis virescens (F.) were exposed to several dosages of γ radiation. Susceptibility to radiation injury decreased as insect development proceeded. Eggs irradiated at an early stage of embryonic development were considerably more susceptible than those exposed at a later stage. Mortality was high in larvae that hatched from irradiated eggs. Larvae were found to be less sensitive than eggs to γ radiation. However, irradiation of larvae resulted in marked mortality in subsequent developmental stages. Many of the adults that emerged from irradiated larvae were malformed. Retardation of growth was also noticeable. (auth)

24715 EFFECTS OF GAMMA RADIATION ON THE TOBACCO BUDWORM. II. IRRADIATION OF MOTHS. El Sayed, E. I.; Graves, J. B. (Louisiana State Univ., Baton Rouge). J. Econ. Entomol., 62: 293-6(Apr. 1969).

Observations were made on the effects of γ irradiation of Heliothis virescens (F.) moths on longevity, oviposition, egg viability, mating frequency, competitiveness of sterilized males, and survival of progeny. Males or females exposed to doses of γ radiation ranging from 35 to 50 krad produced only a few visible eggs when mated to unexposed moths. Conclusions as to mating frequency and longevity of irradiated males and females could not be made because of insufficient data. However, it appeared that sterilizing doses did not seriously reduce longevity or mating frequency. Irradiation of females at 35 to 40 krad resulted in a reduction in oviposition. When both sexes were irradiated and allowed to mate, the egg viability was considerably less than when either sex was irradiated and crossed with unexposed moths. Considerable mortality occurred in the larval and pupal stages of the tobacco budworms that hatched from eggs oviposited by irradiated parents. Death subsequent to hatching increased as the radiation dose increased and was greater when both parents were irradiated than when only one was exposed. Males exposed to 30 krad appeared to be competitive with normal males for virgin females in laboratory studies. The 72-hr LD_{50} values for male and female moths exposed to γ radiation were 192.6 and 190.9 krad, respectively. (auth)

24716 EFFECTS OF GAMMA RADIATION ON THE TOBACCO BUDWORM. I. IRRADIATION OF PUPAE. El Sayed, E. I.; Graves, J. B. (Louisiana State Univ., Baton Rouge). J. Econ. Entomol., 62: 289-93(Apr. 1969).

Effects of γ irradiation on pupae of Heliothis virescens (F.) were investigated in the laboratory using a ^{60}Co source. None of the eggs oviposited by females from eight- to 10-day-old pupae exposed to 30 krad hatched. There was a 96% decrease in egg viability of females mated to males from eight- to 10-day-old pupae exposed to 40 krad. Egg viability decreased 94.8% in crosses when both males and females as eight- to 10-day-old pupae were irradiated with 15 krad. Males irradiated as pupae were not sexually competitive with normal males. Gamma irradiation at sterilizing doses appeared to reduce mating frequency and longevity of males as well as longevity and oviposition of females. Considerable mortality was observed in larvae and pupae resulting from fertile eggs from a cross where either of the parents was irradiated as pupae. Resistance to the effects of γ irradiation increased with pupal age. The LD_{50} values for one- to 3-day-old mixed sex pupae, eight to 10-day-old male pupae, and eight- to 10-day-old female pupae were 6.3, 46.6, and 53.0 krad, respectively. (auth)

24717 STUDIES ON X-RAY DAMAGE IN THE EARLY LARVA OF BOMBYX MORI. Coulon, Madeleine (Faculte des Sciences, Lyon). Compt. Rend., Ser. D, 268: 959-62(Feb. 10, 1969). (In French).

Silkworm larvae were x-irradiated at doses of 4000 to 20,000 R during the early stages. The percentage of mortality at successive

molts is shown by means of a graph. There was direct correlation between radiation dose and mortality percentage. Effects of radiation on duration of larval development and variation in weight during the course of development were also studied. With increasing doses of radiation, increased damage to the larvae was noted. (H.L.W.)

24718 STUDIES ON THE CELLULAR BASIS OF RADIATION LETHALITY. IV. CONFIRMATION OF THE VALIDITY OF THE MODEL AND THE EFFECTS OF DOSE FRACTIONATION. Lange, C. S. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol., 14: 539-51(1968).

The model of Lange and Gilbert (1968) which quantitatively relates the parameters of the planarian survival curve to those of the neoblast (planarian stem cell) survival curve also makes two non-trivial predictions. The first, that planarian mortality probability should decrease exponentially as the number of reproductively intact neoblasts is increased (total tissue volume being kept constant), has already been verified. The second, that LD_{50} should decrease as a logarithmic function of the number of reproductively intact neoblasts (total tissue volume being kept constant), is tested and confirmed. The RBE of $^{90}Sr/^{90}Y$ β rays relative to 300 kVp x rays was found to be 0.7 to 0.8 for D. lugubris. It is also shown that the planarian does not have a superfluity of stem cells, but only enough to ensure survival. Dose fractionation studies show that the neoblasts of D. etrusca can repair some sub-lethal damage within hours after irradiation and/or are triggered into cell cycle, some phases of which are relatively resistant as compared with the resting state. (auth)

24719 SOURCES OF INFECTION IN AN INTENSIVE CARE UNIT. Rountree, Phyllis M.; Beard, Mary A. (Royal Prince Alfred Hospital, Sydney). Med. J. Aust., 1: 577-82(Apr. 6, 1968).

The effect of uv irradiation on the bacterial flora of an intensive care room was determined. Two uv lamps (Westinghouse "Sterilamps") were installed in the room. They were placed flush on the walls above the beds, and reflected the light into the upper part of the room, so that only the upper 7 ft of air received irradiation. The lamps emitted radiation of low intensity at a wavelength of 2537 Å. The intensity of irradiation in the room was measured with a photo cell unit. The investigations included sampling of the ward air, the curtains and equipment surfaces, and examination of the patients' noses and of infected wounds. It was not possible to establish that the use of indirect uv irradiation of the air in this unit conferred any substantial benefit on the patients nursed in it, or had any notable effect on the bacterial content of the air. The bacterial content of the air was at a low level in the absence of irradiation. (BBB)

Vertebrates

Refer also to abstracts 24518, 24522, 24529, 24531, 24552, 24681, 24690, and 24691.

24720 (COO-910-15) BOVINE LYMPHOCYTIC LEUKEMIA: STUDIES OF OCCURRENCE AND DISTRIBUTION INCLUDING INVESTIGATIONS OF FAMILIAL AND ENVIRONMENTAL FACTORS WITH SUPPORTING CLINICAL, HEMATOLOGIC, PATHOLOGIC, INDUCTION, AND TRANSMISSION STUDIES. Progress Report No. 9, 1968-1969. Sorensen, D. K. (Minnesota Univ., St. Paul. Coll. of Veterinary Medicine). Feb. 1, 1969. Contract AT(11-1)-910. 46p. Dep. CFSTI.

Epidemiologic studies on the occurrence and distribution of bovine leukemia in Minnesota were completed. A total of 33 multiple leukemia case herds were studied; 20 of these herds were studied more intensively and for longer periods of time. Hematological studies revealed a persistent lymphocytosis in 27% of the cattle. Cohort analysis of data for adult animals in eleven herds revealed a significant clustering by date of birth of animals with persistent lymphocytosis. A table is presented to show relationship of tumor cases and lymphocytosis to time of birth in multiple case herds; another table shows an analysis of the difference between presence of lymphocytosis and leukemia in dam-daughter pairs. In order to shorten the time required for development of leukemia cows were treated with radiation and prednisolone. Radiation studies included exposure of eight cows with marked lymphocytosis to 25, 50, and 75 R of γ radiation. The ultrastructure of nuclear pockets (blebs) was studied with regard to the significance of lymphocytosis to bovine leukemia. In order to demonstrate virus particles in tissues from leukemic cattle, the following procedures were used: sublethal total body γ irradiation of lymphocytotic cattle, intraperitoneal autotransplantation of lymph node tumor tissues, and phtohemagglutinin induced transformation of lymphocyte cultures. Two types of virus particles were seen with the electron microscope in cultures of lymphocytes treated with phytohemagglutinin. Fetal inoculation studies resulted in the development of inoculation techniques, definition of the period of immune competence to several antigens, and a successful placental transplantation. (H.L.W.)

24721 (NYO-3970-3) CELL PROLIFERATION DURING LYMPHOPOIESIS IN NORMAL AND CONTINUOUSLY IRRADIATED MICE. Fabrikant, Jacob I. (Johns Hopkins Univ., Baltimore, Md. Dept. of Radiological Sciences). [1968]. 24p. (CONF-680413-5; SM-103/41). Dep. CFSTI.

From Symposium on the Effects of Radiation on Cellular Proliferation and Differentiation, Monaco.

Studies on cellular response and cell population kinetics during lymphopoiesis in the thymus of the mouse under continuous γ-irradiation at 45 rads/day are reported. High resolution autoradiography combined with specific labeling of DNA with tritium-labeled thymidine (TcR-^{3}H) provided information on lymphopoiesis in the normal thymus and on the extent to which lymphoid cell population and function can be maintained under the stress of continuous irradiation by changing the patterns of cellular proliferation, such as proliferation rates, cell cycle times, and durations of the constituent phases of the cell cycle. Some preliminary data are available on splenic lymphopoiesis under continuous exposure, and these are referred to for comparison. (auth)

24722 (NYO-3970-7) KINETICS OF LYMPHOID CELL PROLIFERATION UNDER CONTINUOUS IRRADIATION. Fabrikant, Jacob I. (Johns Hopkins Univ., Baltimore, Md. Dept. of Radiological Sciences). Dec. 4, 1968. Contract AT(30-1)-3970. 5p. (CONF-681201-2). Dep. CFSTI.

From Annual Meeting of the Radiological Society of America, Chicago, Ill.

Cellular response and cell population kinetics during lymphopoiesis in the thymus as effected by continuous γ-irradiation at 45 rads/day were studied using high resolution autoradiography and specific labeling of DNA with tritium-labeled thymidine. The thymus was dissected from exposed mice at daily intervals up to 35 days to determine the effects of continuous irradiation on the weight. There was an early fall in weight up to 14 days at which time it leveled off with little further loss in weight. There was a progressive shift in the lymphocyte size distribution to more primitive forms associated with a narrowing of the distribution of cell cycle times bringing about a change in the mean cycle time. The results indicate that the lymphoid cell population can be maintained under continuous irradiation by changing the patterns of cellular proliferation, such as proliferation rates, cell cycle times, and durations of the constituent phases of the cell cycle. (E.R.B.)

24723 MEASUREMENT OF ABSORBED DOSES WITH A FERROSULFATE DOSIMETER. Darenskaya, N. G.; Nelyubov, A. A.; Sokolova, I. K. (Inst. of Biophysics, Moscow). Radiobiologiya, 9: No. 1, 153-5(1969). (In Russian).

The absorbed doses in the organs of a rabbit were measured with the aid of models of the organs filled with a solution of divalent iron. The procedure used permitted a comparison of the results of nonuniform and uniform irradiation of rabbits with x rays. The use of this procedure expands the volume of dosimetric information essential for a qualitative evaluation of biological effects. (JPRS)

24724 DISTRIBUTION OF ^{90}Sr IN VARIOUS PORTIONS OF THE GASTROINTESTINAL TRACT OF CATTLE AFTER CHRONIC INTAKE OF THE ISOTOPE AND THE DOSE RATES CREATED BY IT. Sarapul'tsev, I. A.; Panchenko, I. Ya.; Sirotkin, A. N.; Rasin, I. M.; Shilov, V. P. (Inst. of Biophysics, Moscow). Radiobiologiya, 9: No. 1, 116-19(1969). (In Russian).

The distribution of strontium-90 among various portions of the gastrointestinal tracts of cows after chronic intake of the isotope with feed is nonuniform. Its greatest concentration is observed in the rumen, psalterium, and large intestine. The dose rate in the perimural portion of the intestines is approximately half the dose rate in the contents of the intestines. The distribution of strontium-90 in the lumen of the small and large intestines is more uniform. In a calculation of the dose rates in these organs, it is quite justified to proceed on the basis of the average specific activity of their contents. In the reticulum and psalterium, the dose rates calculated according to the average specific activity of the contents may differ from the true value by 50-100%. After two years of chronic treatment, the dose rate in the gastrointestinal tract of cows is 1-7 mrad/day, and in the skeleton 390 mrad/day. (JPRS)

24725 CYTOCHEMISTRY OF THE ADRENAL GLAND DURING SUBACUTE RADIATION SICKNESS FROM INCORPORATED ^{210}Po. Tkacheva, G. A. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 9: No. 1, 87-93(1969). (In Russian).

The dynamics of the intensity of histochemical responses to ketosteroids, lipids, and succinate dehydrogenase, as well as the change in the fine structure of the adrenal glands of rats under conditions of subacute radiation sickness from incorporated ^{210}Po (0.02 mCi/kg), are evidence of a phase character and synchronization of the functional activity in the cortex and medulla. In the early periods after the injection of ^{210}Po, there is a mobilization of the hormonal substance with simultaneous inhibition of its synthesis. The following stage is the development of compensatory processes and a new decrease in the intensity of hormone synthesis. During the final period, normalization of the function of the adrenal medulla is combined with functional stress of the adrenal cortex as a result of a deficiency of corticoid hormones in the organism. (JPRS)

24726 ZINC CONTENT IN THE TESTES OF RATS AFTER WHOLE-BODY LETHAL IRRADIATION AND CHRONIC IRRADIATION WITH X RAYS. Ginzburg, M. B. (Roentgenoradiological Scientific Research Inst., Moscow). Radiobiologiya, 9: No. 1, 98-100(1969). (In Russian).

The change in the zinc content in the testes of rats under the influence of various doses of ionizing radiation was studied. Among animals irradiated at a dose of 1000 R, the amount of zinc in the testes in the terminal period was doubled with respect to the control. Chronic irradiation at a dose of 1 or 5 R/day for six months led to a three-fold increase in the zinc content in the testes, while irradiation at a dose of 10 R/day for four months led to a six-fold increase in comparison with the control. Irradiation at a dose of 10 R/day for five months produced a five-fold drop in the zinc content with respect to the control. Two months after the end of irradiation, the zinc content in the testes reached the normal level. (JPRS)

24727 MORPHOLOGICAL CHANGES IN THE LUNGS OF RATS AFTER INHALATION OF LARGE DOSES OF SOLUBLE ^{239}Pu COMPOUNDS. Antonchenko, G. P.; Koshurnikova, N. A.; Lyubchanskii, E. R. (Inst. of Biophysics, Moscow). Radiobiologiya, 9: No. 1, 75-80(1969). (In Russian).

The inhalation of plutonium-239 citrate and ammonium plutonium pentacarbonate in amounts producing an initial deposition of ~0.5 to 1.5 μCi of the isotope in the lungs shortens the average lifetime of the rats by 10 to 15 fold in comparison with the control. The pathological anatomical changes in the lungs of the experimental rats after the intake of large quantities of plutonium citrate and ammonium plutonium pentacarbonate (in an excess of ammonium carbonate) do not depend on the chemical form of the inhaled compound and are determined chiefly by the amount of original deposition of the isotope in the lungs. Among the animals that died before the hundredth day, the leading factor was fibrinose-suppurative inflammation of the lungs; among the rats that died after the hundredth day, the leading cause of death was pneumosclerosis. (JPRS)

24728 SOME DATA ON THE CHANGES IN THE SYNAPTIC ENDINGS IN THE SOLAR PLEXUS UNDER THE ACTION OF WHOLE-BODY X IRRADIATION. Dumbrova, N. E. (Inst. of Physiology, Kiev). Radiobiologiya, 9: No. 1, 41-5(1969). (In Russian).

In the work we studied the changes in the synaptic endings in the solar plexus of white rats with the aid of methods of statistical analysis after the influence of whole-body x-irradiation on the animal organism. It was established that there is an increase in the size of the nerve endings, revealed by impregnation with silver nitrate, as well as various dystrophic and destructive damages to them. Among the bulb-shaped and ring-shaped synaptic endings encountered in the solar plexus, the former are more subject to pathological changes. This finds confirmation in a number of literature data. (JPRS)

24729 COMBINED ACTION OF ACCELERATION AND IONIZING RADIATION ON THE HIGHER NERVOUS ACTIVITY AND FUNCTIONAL STATE OF THE VESTIBULAR ANALYZER. Livshits, N. N.; Apanasenko, Z. I.; Meizerov, E. S. Radiobiologiya, 9: No. 1, 46-51(1969). (In Russian).

Guinea pigs and rats were subjected to the combined influence of transverse acceleration and whole-body γ- and x-irradiation. The guinea pigs were irradiated at a dose of 500 R three days after the influence of acceleration, while the rats were irradiated at a dose of 50 R immediately after the end of the action of acceleration. Four types of responses to combined influences were detected: domination of the effect of the dynamic factor at the early periods and of the radiation factor at later periods; domination of the effect of the dynamic factor in part of the animals and of the radiation factor in the other part; a combination of the effects of both factors; a qualitative uniqueness of the responses to the combined influence. The absence of summation of similar effects of acceleration and irradiation and dominance of the effects of acceleration is considered a radioprotective action of the dynamic factor. (JPRS)

24730 EFFECTS OF GAMMA RADIATION AND ITS INTERACTIONS WITH SODIUM HALIDES ON RAINBOW TROUT. Sharma, Rajendra Kumar. Logan, Utah, Utah State Univ., 1968. 107p.

Thesis.

The effects of gamma radiation and the interacting effects of gamma radiation and sodium halides on rainbow trout were studied in the laboratory. The lethal dose studies indicated that response of rainbow trout to a given level of radiation dose can be greatly influenced by the environmental conditions. Environmental stress can have significant interactions with radiation doses and very low or near lethal doses can act in a restorative fashion in delaying or suppressing the mortality. Median lethal dose levels can fluctuate over a wide range for experiments conducted in different experimental facilities. The high doses of radiation and the medium levels of sodium bromide and of sodium chloride exhibited antagonistic interactions. Interacting effects of radiation dose and sodium fluoride, if any, were masked by the lack of differences in mortalities in different treatment combinations due to the lack of calcium and magnesium in the soft water used. A synergistic interaction was apparent for the radiation dose by sodium iodide concentration effect. (Diss. Abstr.)

24731 EFFECTS OF WHOLE-BODY IRRADIATION ON BABY PIGS (SUS SCROFA). Case, Marvin Theodore. Urbana, Ill., Univ. of Illinois, 1968. 114p.

Thesis.

Since the available literature was limited to that on irradiation of older swine and not baby pigs, it was decided to expose new born Yorkshire pigs to 150R of x-radiation from a 280 KvP, 20 ma source and 150R, 250R, 300R, 350R, 375R, 400R, and 450R of gamma radiation from a ^{60}Co source. The $LD_{50/30}$ of the new born pigs was 375R of gamma radiation from a ^{60}Co source. Radiation deaths occurred 10 to 29 days post irradiation. The irradiated pigs had diarrhea 2 to 5 days post irradiation, had a reduced growth rate 14 days post irradiation, and had cutaneous hemorrhages 9 to 14 days post irradiation. The pigs exposed to lethal dosages of radiation (375R, 400R or 450R) had hemorrhages in the heart, lymph nodes, skin, skeletal muscle, serosa of intestine, kidney, brain and liver. Hemopericardium, hemoperitoneum or hemorrhage into the intestinal lumen were often severe enough to cause death. Histologic examination of tissues of irradiated baby pigs disclosed extensive destruction of hematopoietic cells in bone marrow and lymphoid organs. The lymph nodes and spleen of new born pigs had limited lymphoid development and extramedullary hematopoiesis was present in the spleen. An interval of 21 days was required for complete lymphoid development of the spleen and lymph nodes and for extramedullary hematopoiesis to cease in the spleen in the control pigs. Irradiation caused rapid disappearance of extramedullary hematopoiesis in the spleen and delayed the lymphoid development of lymph nodes and spleen for 21 days. Since the lymphocyte was one of the most radiosensitive cells in the body, the irradiated pigs rapidly developed lymphopenia. The length of time that lymphopenia persisted was dose dependent. Bone marrow damage caused neutropenia and anemia to develop 10 to 14 days post irradiation. Thrombocytopenia was believed to be the major cause of the hemorrhages in the irradiated pigs. More severe lymphopenia, neutropenia, and anemia were found in pigs exposed to 150R x-radiation than in pigs exposed to 150R of gamma radiation. (Diss. Abstr.)

24732 ELECTRON MICROSCOPIC STUDY OF THE RABBIT CILIARY BODY IRRADIATED WITH X-RAYS IN COMPARISON WITH THE RESULTS OBTAINED WITH FAST NEUTRONS. Mukai, K. Nippon Ganka Kiyo, 19: 370-1(Mar. 1968). (In Japanese).

Forty-four eyes of 22 10-week-old albino rabbits were exposed to 180 kv x-rays (dose: 1000 R and 2000 R). The anterior segment of the globe and the optic media were observed by biomicroscope, while the ciliary body was studied by light and electron microscopes up to a maximum period of 10 weeks after irradiation. The results obtained were compared with those obtained with the use of fast neutrons previously reported. The results were as follows: The ciliary bodies of all eyes exposed to x-rays and fast neutrons developed inflammatory reactions in the stroma during the period following irradiation. Then gradually there developed a retrograde degeneration of epithelial cells. The inflammatory reaction of the ciliary body stroma was markedly greater in the x-ray exposed group. On the other hand, the latent period of lenticular changes following irradiation was shorter for a fast neutron exposed group and the degree of lenticular opacity present 4 to 10 weeks after irradiation was also greater in this group. Although ciliary body disturbances induced by x-ray and fast neutron ir-

radiations have secondary effects upon the development and progress of lenticular changes, those effects seem rather insignificant. (auth)

24733 COMPARATIVE ANALYSIS OF SINGLE AND FRACTIONAL IRRADIATION ON A NORMAL AND TUMOR TISSUE WITH THE SIMILAR MITOTIC ACTIVITY. Shiffer, I. V. (Central Roentgen-Radiological Inst., Leningrad). Byull. Eksp. Biol. Med., 67: 66-9(Jan. 1969). (In Russian).

Effects of single and fractionated doses of radiation (1000 and 2000 R) on mitotic activity of corneal epithelium and ascites tumors in mice were studied. Effects of single doses of radiation on tumor tissues were longer lasting than those on normal tissues. Fractionated doses resulted in summation effects. (auth)

24734 TUMOR TISSUE STRUCTURE AND RADIOSENSITIVITY. II. MAMMARY CANCER IN C_3H/He.Ms. STRAIN MICE. Niibe, Hideo; Tobe, Tatsuo (Gunma Univ., Maebashi, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 1341-9(Jan. 1969).

Histological investigations were performed on the relation between tissue structure and radiosensitivity of tumors. The materials were tumors of the first generation after transplantation of the spontaneous mammary cancer of C_3H/He.Ms. into the thigh muscle of mice of the same strain. Histologically, the tumors were adenocarcinomas of relatively lower differentiation, consisting mainly of solid proliferation of cubic or cylindric cells with near circular nuclei, and partly forming glandular lumen. In a group of the tumor cells, exhibiting carcinoma simplex-like solid proliferation, the growth was vigorous and the radiosensitivity was higher, while in the other cell group, exhibiting glandular structure and tendency of differentiation, the growth potency as well as the sensitivity was lower. In previous experiments with Yoshida sarcoma and methylcholanthren-induced sarcoma there was a correlation between growth potency and radiosensitivity of tumor that was dependent on the distance between tumor cells and the blood vessel. In the mammary cancer of C_3H/He.Ms. mice, however, the sensitivity was not always determined by the distance from the blood vessel, but the findings indicated that it was rather the differentiation of the tumor that played a more important role in determining the growth potency as well as the sensitivity of tumor. Now we are continuing investigation on human cases in order to know whether the findings obtained from the mammary cancer of C_3H/He.Ms. strain mice are inherent to adenocarcinomas in general. (NSA of Japan)

24735 A FUNCTIONAL AND MORPHOLOGICAL STUDY OF LIVER RADIATION INJURY FOLLOWING INTRAVENOUS INJECTION WITH COLLOIDAL GOLD (^{198}Au). Wordsworth, O. J.; Dykes, P. W. (Univ. of Birmingham, Eng.). Int. J. Radiat. Biol., 14: 497-515(1968).

Rose bengal tests were carried out and serum concentrations of alanine amino-transferase (AlT), aspartate aminotransferase (AsT), total protein and albumin determined at different times up to 6 months after intravenous injection of colloidal ^{198}Au calculated to deliver beta doses of 3,000 to 11,000 rads to the liver of rats. AlT and AsT were also determined in serial liver biopsies in an attempt to correlate functional and histological changes. Serum AlT was a reasonably sensitive index of liver radiation damage, and both serum AlT and serum AsT exhibited marked dose effects. Serum proteins were poor indices of damage. Functionally and histologically there was a characteristic and progressive lesion which resulted in eventual death in the higher dose groups. In addition to previously described histological changes, nuclear inclusions of cytoplasmic material were commonly seen in the radiation-damaged livers. (auth)

24736 PRESENT KNOWLEDGE OF THE EFFECTS OF RADAR WAVES ON LIVING ORGANISMS AND APPROPRIATE PROTECTIVE MEASURES. PART 1. GENERAL PHYSICAL PRINCIPLES AND PHYSIOPATHOLOGICAL EFFECTS. Busco, R.; Comignani, L. Riv. Med. Aeronaut. Spaz., 30: 469-528(July-Sept. 1967). (In Italian).

The authors review the present state of knowledge of the effects of radiofrequency waves, based on several years laboratory studies and observation of persons exposed to radar waves. An attempt is also made to predict the future admissible intensity of this radiation and the corresponding safety measures to be adopted to prevent irreversible lesions. Aspects covered include: electromagnetic waves (technical survey, radar); the physiopathological effects of electromagnetic waves; and the biological effects of very-high-frequency electromagnetic waves. (Occup. Safety and Health Abstr.)

24737 CHANGES IN SIZE DISTRIBUTION OF BLOOD LYMPHOCYTES FOLLOWING INHALATION OF RADIO-EUROPIUM. Berke, H. L.; Wilson, G. H.; Berke, E. S. (Wayne State Univ., Detroit). Contracts AT(11-1)-1181; AT(11-1)-1630. Int. J. Radiat. Biol., 14: 561-5(1968).

Following inhalation of radioactive europium by the rat, the ratio of large to small lymphocytes progressively increases in exponential relationship to cumulative dose. Since a similar relationship was found for repetitive external x-irradiation it may be possible to determine, in vivo, the dose equivalence and relative biological effectiveness of radiation sources of various kinds under comparable experimental conditions. (auth)

24738 ANESTHETIC GASES AND WATER STRUCTURE: THE EFFECT OF XENON ON TRITIATED WATER FLUX ACROSS THE GUT. Berger, Eugene Y.; Peckikyan, F. Rene; Kanzaki, Grace (New York Univ., N. Y.). J. Gen. Physiol., 52: 876-86(Dec. 1968).

The flow of ^3H_2O across the mucosal surface of rat cecum as affected by Xe, as an anesthetic gas, was studied. To evaluate the effect of exposure to Xe on tritiated water flux, each cecum served as its own control. When Xe comprised 50% of the total gas flow, tritiated water flux across the cecum slowed by 7.8 ± 2.2% (mean ± standard error). When Xe comprised 80% of total gas flow, water flux slowed by 12.9 ± 3.3%. These findings are consistent with the theory that the presence of an anesthetic gas in tissue induces a cage-like arrangement of hydrogen-bonded water molecules. The mechanism for the delay in ^3H_2O flux is related to an increase in hydrogen-bonded water molecules in the tissue when Xe is present. The water molecules would be those associated with a surface, such as that presented by -a protein. When water is structured around protein by noncovalent interactions, potential cavities are possible (free volumes) which may accommodate a molecule of the gaseous anesthetic. The presence of Xe in such a cavity gives stability by its van der Waals force to this cloud of water molecules or ice cover around the protein. The average span of time any individual water molecule spends in any one position associated with a protein molecule is probably a matter of a fraction of a second so that while the structure of the cloud around the protein is preserved, there is a continuous split second shuffling of the individual water molecules. (BBB)

24739 ULTRASTRUCTURAL CHANGES OF THE CARDIAC MUSCLE CELLS AFTER TOTAL BODY IRRADIATION. Boccardi, S.; Morano, E. (Univ., Turin). Minerva Radiol., 13: 633-8(Nov. 1968). (In Italian).

The behavior of the cardiac muscle cells was investigated in guinea pigs subjected to total body irradiation (300 R). Examination of the ultrastructural changes showed a slight decrease of the mitochondria, some of which revealed alterations consisting in a separation of the cristae and a slight clearing of the matrix. The endocytoplasmic reticulum showed areas with dilatation of the glycogen: the glycogen granules were slightly decreased in number and irregularly scattered. This indicates an initial alteration of the endocellular metabolism. (auth)

24740 GROWING BONES ON THE COMPUTER: SOME PITFALLS OF A COMPUTER SIMULATION OF THE EFFECTS OF RADIATION ON BONE GROWTH. Kember, N. F. (Royal Free Hospital, London). Cell Tissue Kinet., 2: 11-20(Jan. 1969).

The linear arrangement of the proliferating cells in the growth cartilage of bone provides an apparently simple system for studying the relationship of cell kinetics to a gross endpoint, i.e., bone growth. The system has been reduced to a simple computer model which follows the effects of radiation on the growth of fifty or one hundred individual cartilage columns. When the computed data were compared with experimental curves some factors were discovered that had been omitted from the original model. A revised model proved of limited value in sorting out the relative importance of competing kinetic parameters but indicated some directions for future experimental studies. (auth)

24741 LEUKEMOID REACTION AFTER ^{90}Sr-INCORPORATION IN RATS. Boegler, F.; Kriegel, H. (Heiligenberg-Institut, Heiligenberg/Baden, Ger.). Blut, 17: 345-50(Sept. 1968). (In German).

Injuries of the hematopoietic system after incorporation of ^{90}Sr were studied in rats following administration of 0.15 μCi/g body wt. After 300 to 800 days leukocyte counts were normal in 6% of the animals studied, between 15,000 and 20,000 in 16%, and more than 20,000/mm^3 in 78% of the animals. Lymphocytes, granulocytes, monocytes, and eosinophils had a relative count of 77, 20, 2, and 1%. The granulocyte group increased by 238%, and the lymphocyte fraction decreased by 64% from its initial value. There was no increase in early myeloid or lymphatic forms. At death, osteosarcomas were observed in 4% of the animals. Round or spindle cell carcinomas were observed in 6%, but in 78% various neoplasms of the hematopoietic system were found. There were leukemoid infiltrations in liver, spleen, lungs, and kidney; spleen enlargement; and mediastinal and mesenteric tumors. The find-

ings indicated leukemoid reactions, but not a definite transition to leukemia. (BBB)

24742 DISTRIBUTION AND MULTIPLICATION OF COLONY FORMING UNITS FROM BONE MARROW AND SPLEEN AFTER INJECTION IN IRRADIATED MICE. Lahiri, S. K.; van Putten, L. M. (Radiobiological Inst., Rijswijk, Netherlands). Cell Tissue Kinet., 2: 21-8(Jan. 1969).

The distribution and proliferation of CFUs from bone marrow and spleen cell suspensions were followed after injection in lethally irradiated isogeneic mice. It was found that a larger proportion of the injected bone marrow CFUs than of the spleen derived CFUs could be recovered from the recipient's spleen and femur. This consistently higher recovery points to the conclusion that a larger fraction of bone marrow-derived CFUs than of spleen-derived CFUs is capable of producing daughter CFUs, most likely caused by a commitment to early differentiation of many spleen CFUs. (auth)

24743 KINETIC PROPERTIES OF HAEMOPOIETIC STEM CELLS. Lajtha, L. G.; Pozzi, Laura V.; Schofield, R.; Fox, Margaret (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Cell Tissue Kinet., 2: 39-49(Jan. 1969).

A comparison of the exocolonizing and autorepopulating tests for haemopoietic stem-cell assay indicate that the "overshoot" in splenic colony formation, observed 12 to 14 days after 150 rad total-body radiation (TBR), only occurs with the autorepopulation assay. The explanation is that the priming dose of 150 rad increases the absolute seeding rate of stem cells from the marrow. A seeding rate significantly greater than normal can "take" only if the spleen is available—it can expand and accommodate stem cells while the bone marrow cannot. If, however, the absolute number of colony-forming cells are decreased in the femur, a relative increase in seeding rate can take place even in the splenectomized animal. Evidence is presented concerning the different turnover states of exo- and autorepopulating stem cells (CFU) and those responsible for erythropoietic response (ERC), and the precursors of agar colony-formers. (auth)

24744 ACUTE RADIATION SYNDROME IN THE POT-BELLIED PIG. Morczek, A.; Schmidt, W. (Medizinische Akademie, Magdeburg, Ger.). Ger. Med. Month., 12: 234-8(May 1967).

To ascertain whether the results of radiobiological studies on small lab animals are applicable to larger mammals, a colony of pot-bellied pigs was developed for radiation experiments, the ultimate object being to apply the experimental results to man. In studies on the acute radiation syndrome, young pot-bellied pigs of both sexes were given single exposures to x rays, the average surface dose being of 300, 400, 500, or 600 R, and the clinical, hematologic, and necropsy findings were noted. In this species radiation sickness was characterized by loss of weight, beginning soon after exposure, and the development of edema. This was followed by loss of appetite, weakness, diarrhea, and dyspnea. In animals exposed to sublethal doses (300 R) the only changes were transient loss of appetite and weight. The hematologic effects were similar to those seen in man. After 300 or 400 R there was an initial depression of leucocytes, platelets, and reticulocytes followed by gradual recovery. The reticulocytes reached their original level in 2 to 3 weeks and the platelets in 6 weeks, though at the end of 8 weeks' observation the leucocytes had still not reached the basal level. After irradiation with supralethal doses the leucocyte and platelet counts fell progressively without any sign of regeneration and death soon followed. The red cell changes were less striking. The hematologic events which followed moderate radiation doses (400 R) are shown. Necropsy showed evidence of a hemorrhagic diathesis, with massive hemorrhages in nearly all organs and shrinkage of the lymphoid tissue. (BBB)

24745 BLASTULAR ARREST AND CHROMOSOME ABNORMALITIES PRODUCED BY X RAYS IN TWO AMPHIBIANS: RANA PIPIENS AND XENOPUS LAEVIS. Ursprung, Heinrich; Leone, Janet; Stein, Louis (Johns Hopkins Univ., Baltimore). J. Exp. Zool., 168: 379-86(July 1968).

Whether chromosomal abnormalities induced at various pregastrular stages of development were necessarily related to blastular arrest was investigated and an attempt to correlate given abnormalities of the karyotype with blastular arrest was made. In R. pipiens, to establish the dose-effect relation in the production of developmental arrest, newly fertilized eggs were x irradiated with various doses ranging from 400 to 1400 R. After 400 R the initiation of gastrulation was not markedly affected. Most embryos reached the yolk-plug stage. Development beyond this stage, however, was not normal, as indicated by various abnormalities observed 48 hr after irradiation. After 650 R ~ 1/8 of the embryos became arrested at stage 9 of development, but many embryos completed gastrulation and reached stage 12. At 900 R a new syndrome, partial cleavage, was observed. Partially cleaved embryos resembled stage 9 arrested embryos in that cell size of the animal halves of such embryos was indistinguishable from normal stage 9 blastulae. More than 1/2 of all irradiated embryos failed to develop past the late blastula stage. The percentage of such arrested embryos increased as the dose of irradiation increased further. Qualitatively, similar results were obtained when fertilized eggs of X. laevis were irradiated. The dose range in these experiments was from 250 to 3000 R. It was found that production of chromosomal abnormalities in irradiated amphibian zygotes was not necessarily followed by blastular arrest. At an x-ray dose that produced blastular arrest in 20% of the irradiated embryos, over 90% of the embryos were found to contain cells with gross chromosome aberrations. Different pregastrular stages were differentially sensitive towards x-ray-induced blastular arrest. (BBB)

24746 THE ANATOMIC-PATHOLOGIC CONSEQUENCES OF ABDOMINAL IRRADIATIONS. Zollinger, Hans U. (Univ., Basel). Sem. Hop. Paris, 44: 423-34(Feb. 8, 1968). (In French).

The cytologic changes caused by ionizing irradiation, and the pathologic effects in stomach, small intestine, colon, rectum, liver, kidney, ureter, and bladder are reviewed. The marked radiosensitivity of intestinal epithelium is emphasized. The cellular alterations which are described appear soon after irradiation, as a swelling of mitochondria and dilatation of the pores of the nuclear membrane. Changes induced by specific doses are outlined. Changes in the ileum begin after ~2500 R. The interaction of radiation with the regeneration cycle of mucosal cells in the crypts of the villi is described in terms of the electron microscopic findings. Two or three days after irradiation the number of mitoses is increased. Effects of Thorotrast deposits on surrounding tissues are illustrated and discussed. (BBB)

24747 EXPERIMENTAL AND MORPHOLOGICAL STUDIES ON THE ABNORMAL DEVELOPMENT INDUCED BY 14.1 MeV NEUTRON IRRADIATION IN UTERO. Sawasaki, Mamoru (Hiroshima Univ.). Hiroshima Daigaku Igaku Zasshi, 16: 397-423(Apr. 1968). (In Japanese).

Donryu-strain, pregnant rats were subjected to neutron-beam irradiation, and on the 18th day of pregnancy, they were sacrificed and autopsied. Then the abnormal development was studied on 1077 fetus obtained. The results were as follows: The incidence of absorbed embryos became higher as the irradiated dose increased, and was high in groups irradiated on the 8th or 9th day of embryonal development. The sex ratio of fetus was 102.7 in the control group, and was somewhat higher in the irradiated groups, with the average value of 119.8. It was about 130 in the groups irradiated with dose of 100 or 130 rad. Malformations were found in 671 fetuses (62.3%), and their incidence increased as the dose increased. When classified by organs, the cardiovascular malformation was most frequently observed, followed by hernias in thoracic and abdominal regions and malformations in the central nervous system (CNS). Malformations in limbs and tail, face, urogenital system and so on were also found. Their incidences were high in the groups irradiated on the 8th day of embryonal development. Multiple malformations were observed in 44% (295 fetus) of the whole deformed fetus, and were combined with the cardiovascular malformation in many cases. Usually, the combination of the cardiovascular malformation with hernia in thoracic and abdominal regions or CNS malformation was found. (NSA of Japan)

24748 MODE OF ACTION OF TERATOGENIC AGENTS. Theiler, K. (Univ., Zurich). Wien. Med. Wochensch., 118: 63-4(Jan. 27, 1968). (In German).

The effects of ionizing irradiation in producing teratogenic effects were discussed. It was not possible to detect a threshold irradiation dose that was not teratogenic. In pregnant mice x-irradiated with a dose of 200 R, three periods of relative susceptibility to teratogenic effects were observed. The first was during the implantation period when irradiation either killed the developing embryo or had no teratogenic effects. During the second phase, while the fetal organs were developing prenatal mortality from irradiation, they decreased markedly. However, the number of malformations increased enormously and reached almost 100% on the eighth day. In the final phase of pregnancy when the fetal organs were growing at a steady rate the number of malformations caused by irradiation dropped abruptly. The most dangerous period when the most malformations were induced was also the period of organogenesis. The increased sensitivity to irradiation was possibly due to effects on cells with a high rate of proliferation. In humans the most dangerous period was observed to be the first trimester, from the second to the sixth or seventh week of pregnancy. (BBB)

Man

Refer also to abstracts 24251, 24623, 24624, 24647, 24664, 24698, 24700, 24701, 24704, and 24736.

24749 (A-AC-82/G/L-1263) POSSIBILITY OF HARMFUL EFFECTS OF LOW DOSES OF IONIZING RADIATION ON THE FUNCTIONING OF THE MATURE CENTRAL NERVOUS SYSTEM. Livishits, N. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1968. 10p. (In Russian). Dep.

The reaction of the central nervous system to low-level radiation, of the order of several roentgens, causes changes in the bioelectric activity of the brain and affects the conditioned reflexes; it is a biological response to stimulus and not an indication of the injurious action of the radiation. Statistically significant changes in the activity of the higher nervous system have been observed in animals exposed to doses of 4 to 6 rad; although these effects are not necessarily pathological, they indicate a worsening of the functions. The effects are later compensated, even if the exposure continues. A further increase of the dose results in alternating compensating and worsening stages. It was found that the effects of extended exposure to low levels of radiation are cumulative. Irradiation at the 5, 25, and 25 R level results in marked injury, convulsions, and an increase of the toxic effect of cystamine. A narrowing of the achromatic field of vision was noted in persons exposed to an occupational irradiation in excess of 300 rem. (TTT)

24750 (ABCC-67-68) ANNUAL REPORT, JULY 1, 1967-JUNE 30, 1968. (Atomic Bomb Casualty Commission, Hiroshima, Nagasaki (Japan)). 323p. (In Japanese and English). Dep.

Activities of the Atomic Bomb Casualty Commission (ABCC) are reported in relation to administrative activities, community relations, technology and research, and scientific conferences. Research projects undertaken by the ABCC and in cooperation with the Japan National Institute of Health (JNIC) continue in the following areas: basic radiation estimates, population studies, genetics, growth and development, mortality, morbidity, and a variety of specific diseases or disorders. During the year, 30 technical reports of research activities were approved for publication. Abstracts of these reports are included. The research projects deal primarily with atomic bomb survivors with documented acute radiation symptoms, but other groups in the post-exposure population are used for comparative purposes. Also included in this report are the fiscal and physical aspects of the commission's activities as well as the extensive public relations program that is a vital aspect of the commission's overall program. An extensive appendix is included containing lists of staff members, members of the various study groups, policies and practices of the ABCC, titles of research and technical publications, statistics on various pathology studies and population surveys, and a list of approved research projects conducted by the commission. (E.R.B.)

24751 SOME HEMATOLOGICAL PARAMETERS IN 7- AND 14-YEAR-OLD SCHOOL CHILDREN FROM THE ENVIRONMENT OF THE CONSTRUCTED ATOMIC POWER PLANT IN SLOVAKIA. Hecko, I.; Grunt, J. Cas. Lek. Cesk., 106: 596-600(May 25, 1967). (In Czech).

Hematological examinations were made on 328 seven-yr-old and 265 fourteen-yr-old school children. A detailed account of the results is presented and data are compared with those obtained by other workers. The advantages of accurate, standardized methods in hematology are pointed out. (auth)

24752 CLINICAL EXPERIENCE ON RADIATION REACTION IN THE AGED. Wachtler, F. (Univ., Vienna). Krebsarzt, 22: 361-6(1967). (In German).

Radioinduced acceleration of senescence resulting in a dose dependent reduction of life span is discussed. This effect is not noticeable in cancer therapy because the irradiation is given to a limited part of the total body. It is argued that malignancies in advanced age show less tendency to growth and metastasis. The importance of the proliferation of the connective tissues to the recovery after radiation lesions is emphasized. The effect of radiation on aging bone structure is discussed as is also the influence of aging on the course of reactions following pulmonary radiation. (auth)

24753 PATHOGENETIC AND CLINICAL ASPECTS OF RADIATION INJURY BY X-RAY IN DENTISTRY. Merlini, C. (Univ. Milan). Rass. Trim. Odontolat. 48: 553-68(Oct.-Dec. 1967). (In Italian).

The etiopathogenesis of the oral lesions that appear in patients treated with x rays for tumors of the oral cavity is discussed in reference to the teeth lesions. Indications for the stomatologist for before, during, and after radiotherapy are presented. (auth)

24754 LATE INJURIES AFTER THE TREATMENT OF ANKYLOSING SPONDYLITIS WITH THORIUM X AND PETEOSTHOR. Haike, H.; Steltner, D.; Schulze, H. (Univ., Duesseldorf). Z. Orthop. Ihre Grenzgeb., 102: 372-80(Mar. 1966). (In German).

The authors report on follow-up examinations of patients with ankylosing spondylitis treated 10 and more years ago with Th X or Peteosthor. Of the 60 patients treated in our hospital from 1949 to 1955, 45 could be followed up. Beside clinical examinations the patients were subjected to examinations in a whole-body measuring device to detect possible residual radioactive substances from the contamination by the formerly administered Th X. Apart from the gamma rays emitted by every human being due to radioactive potassium and calcium no signs were found in the radiation spectrum indicating thorium disintegration products. When comparing the therapeutic results of the patients, then of an average age of 41 years, with present-day findings, in 8 (19.5%) a permanent improvement was seen which, however, cannot be considered exclusively a success of treatment with Th X, since additional physiotherapeutic treatment was given continuously. No patient was free from complaints. Investigation of the peripheral blood values yielded no unequivocal pathological findings. One patient died of paramyeloblastic leukemia at the age of 43. Here alone Th X-treatment can be considered the most probable cause. When comparing radiograms made now with those produced at the time of Th X treatment, a marked increase in the ossification processes is noticeable. Thus, pathological ossification could, at length, not be prevented by Thorium X. (auth)

24755 ANAPLASTIC CARCINOMA OF THE KIDNEY IN RENAL THOROTRASTOSIS. Lohse, R.; Uhrig, D.; Irmscher, J. (Medizinische Akademie Carl Gustav Carus, Dresden). Zentralbl. Chir., 93: 651-9(May 4, 1968). (In German).

An anaplastic renal carcinoma probably due to the use of Thorotrast 30 yr previously for a unilateral retrograde pyelography was described and discussed. The fibrogenetic effect of the Th in combination with inflammatory changes and irradiation injuries of the cells probably induced the tumor. The clinical symptoms of the Th tumor included severe pain, other subjective symptoms, and recurrent hematuria. The renal thorotrastosis was visible by x ray. It was concluded that a unilateral renal thorotrastosis should be removed by nephrectomy, even though there was no evidence of malignant changes. In aged patients, however, and in patients with thorotrastosis in both kidneys, surgical intervention would require more consideration. (BBB)

24756 SOMATIC HAZARD FROM DENTAL RADIOLOGY. Smith, N. J. D. (King's Coll. Hospital, London). Brit. Dental J., 125: 256-60(Sept. 1968).

The hazard to the somatic tissues of the patient which arises from dental radiology was discussed. Representative values of the skin dose for both single exposures and for full-mouth surveys were given. The skin dose from 1 intra-oral radiographic exposure may vary from less than 1 rad to around 5 rad, depending on the physical factors. The skin dose at any one point on the face which results from a 14-film full-mouth survey can vary from less than 5 rad to ~50 rad. The biological effects of irradiation, including the early effects, cataractogenesis, carcinogenesis, and leukemogenesis were described and discussed briefly. The risk of any early pathological effects, cataract development, or carcinoma induction was shown to be negligible. The possibility of a real risk of leukemia induction was discussed. Depending on the method of assessing this risk, the number of cases of leukemia which could arise as a result of the practice of dental radiology in the United Kingdom may be as low as 1 case/century, or as high as 1 case every 3 yr. (BBB)

24757 ACCIDENTAL RADIATION BURNS FROM SUPERFICIAL X-RAY EQUIPMENT USED IN SCIENTIFIC LABORATORIES. Donald, G. F.; Norrish, K. (Queen Elizabeth Hospital, Adelaide). Aust. J. Dermatol., 9: 244-7(June 1968).

A case of accidental radiation burns from handling an x-ray tube is reported. The patient had been working with his finger tips only 1 or 2 cm from the face of the tube. After 8 days following exposure slight tenderness developed on the tips of all fingers of the left hand and by day 9 a faint erythema was visible. In 14 days the tips of the index and ring fingers of the left hand showed deep-seated vesiculation. Oral betamethasone was commenced in a dose of 3 mg/day. During the next few days the areas of vesiculation increased and by day 19 small areas of circumscribed pale erythema showed for the first time on the palmar aspect of the left index and middle fingers, and because of this apparent lack of response the betamethasone was stopped. This was followed by a rapid increase in blistering and swelling and a marked increase in

pain. Betamethasone therapy was given in a dose of 6 mg/day and within 48 hr edema and tenderness decreased considerably. By day 28 the erythema and vesiculation had greatly lessened and the betamethasone was stopped progressively. By the sixth week all blisters had dried and the lesions exfoliated, beginning in the areas which were last to appear. By the tenth week small ulcers remained on the pulps of the thumb and the ring finger and a delicate wrinkling of the skin with loss of the fingerprint pattern on the pulps of the index and little fingers. The ulceration of the ring finger took 5 months to heal and all injured areas remained very sensitive to pressure or slight changes of temperature for many months. Small dry, scaly, telangiectatic scars remained on the pulps of all 5 fingers of the left hand. (BBB)

24758 RADIATION HAZARDS. Bonnell, J. A. (Central Electricity Generating Board, London). pp 191-203 of Third Symposium on Advanced Medicine. Dawson, A. M. (ed.). Baltimore, Williams and Wilkins Co., 1968.

From 3rd Symposium on Advanced Medicine, London, England. See CONF-670221.

Effects of exposure to ionizing radiation are briefly discussed. Acute severe exposure to ionizing radiation gives rise to early and specific symptoms, the acute radiation syndrome. The long-term or chronic effects of exposure to radiation are of greater fundamental importance from the point of view of environmental medicine. These are the increased incidence of malignant disease, the overall reduction in life span, increased incidence of developmental abnormalities (somatic effects) and the genetic effects of ionizing radiations. The natural background varies enormously in different parts of the world. It is of the order of 100 mR/yr in England, but may be as high as 4000 mR/yr in the monazite sand areas of Brazil. In the small area of Britain there is a considerable variation in background radiation between the granite areas of Aberdeen and Cornwall and the chalk areas of southeast England. The external dose rate measured out of doors in Aberdeen is twice that in Edinburgh, 104 mR/yr as compared to 48.5. This variation is considerably greater than the addition to background radiation due to world-wide fallout from nuclear weapon testing. The increased sensitivity of embryonic tissues to radiation depends largely on their stage of development when the dose of radiation is received. In the mouse the abnormalities encountered following irradiation between the 7th and 13th days of gestation, which is approximately equivalent to the 2nd and 6th weeks in human development, include microphthalmia, coloboma, spina bifida occulta and urogenital abnormalities. Of children exposed in utero to radiation at Hiroshima and Nagasaki, 12 were found with mental retardation and microcephaly. All embryos irradiated at 7 to 15 weeks and within 1200 m of the hypocenter were affected. (BBB)

24759 PLACENTAL SCANNING. Lowen, W. (Royal Women's Hospital, Melbourne). Med. J. Aust., 2: 641 (Oct. 12, 1968).

The dangers of placental scanning and the possibility of damage to radiation-sensitive tissues of the fetus are briefly discussed. The dangers are far more imaginary than real, as far as this procedure is concerned. The amount of radiation received by the fetus is 10 to 25 mrem. The amount of radiation received from the natural background is about 50 to 100 mrem/yr in Australia, and it is much higher in other regions, for example: United Kingdom, 100-300 mrem; Sweden 200 mrem; and in some places it reaches a figure of 900 mrem. There is no evidence to show that there is any increased incidence of leukemia or congenital deformities in those parts of the world, compared with Australia. It is admitted that the dose received by the maternal and fetal thyroid is much higher when ^{131}I is used, but firstly, this can largely be reduced by prior administration of a few drops of Lugol's solution, and secondly, ^{131}I is being replaced by other radioisotopes, such as ^{51}Cr and ^{99m}Tc, which have no specific target effects. (BBB)

24760 THE PROBLEM OF RADIATION CATARACT IN BETA IRRADIATION OF THE ANTERIOR EYE SEGMENT. Lommatzsch, P. (Humboldt-Univ., Berlin). Klin. Monatsbl. Augenheilk., 150: 683-8 (1967). (In German).

Effects of ^{90}Sr irradiation on the anterior lens were studied and reviewed. Even though the dose fell rapidly in the tissues, peripheral portions of the lens at only 3 to 4 mm distant from the limbus received considerable irradiation when a ^{90}Sr β applicator was used to treat tumors. It was estimated that a radiation cataract will develop if 300 R or more are absorbed by the lens. If the surface dose was 10,000 rep at the limbus, lens opacity developed in 50% of the cases after 2 to 10 yr. The peripheral subcapsular opacities remained stationary and vision did not fall below 20/40. At the lens equator 3 mm from the limbus ~12% of the irradiation dose was absorbed. When the dose was more than 5000 rep, a cataract developed after 2.5 yr. The subcapsular opacities had small vacuoles, and 79% slowly increased in intensity and size, 11% remained constant, and 9% regressed. In only 5% of the ^{90}Sr irradiations the clouding reached the posterior pole of the lens, and in 1.6% of the cases a cataract extraction was required. Irradiation of the central cornea with 20,000 to 40,000 rep produced slight clouding of the lens at the posterior suture, but clouding was produced after β irradiation of the limbus with doses of 2000 to 12,000 rep. Cataracts developed after 3 to 6.5 yr. Postoperative β irradiation of the pterygium with doses of 3000 to 5000 rep produced peripheral subcapsular clouding in 6% of patients treated. In 38 patients who received from 12,000 to 15,000 R of β irradiation of the limbus 2 developed cloudiness at the lens periphery. (BBB)

24761 EFFECTS OF PRENATAL IONIZING RADIATION ON THE FETUS WITH SPECIAL REFERENCE TO DIAGNOSTIC RADIOGRAPHY. Gefferth, Karoly. Orv. Hetil., 108: 2031-3 (Oct. 22, 1967). (In Hungarian).

Recent studies accumulated strong evidence that even routine diagnostic x-ray examinations may cause radiation injury to the patient or his descendents. A single relatively large or repeated small doses after conception may result in the premature death of the fetus or in delayed disorders, such as malignancy in children who were apparently healthy at birth. Irradiation before conception may cause injury in later, even to the sixth, generations, causing premature death or organic disorders. The physician must take strict steps to limit taking x-ray pictures and to provide the best possible protective measures for people in child-bearing age; abdominal examination of young women must be avoided during the second half of the cycle, as an as yet undetected pregnancy may be present when the embryo exhibits the highest sensitivity toward radiation. (TTT)

24762 ANAPLASTIC THYROID CANCER TWELVE YEARS AFTER RADIOIODINE THERAPY. Baker, Harvey W. (Good Samaritan Hospital, Portland, Oreg.). Cancer, 23: 885-90 (Apr. 1969).

A patient received 2 doses of radioiodine for a diffuse goiter in 1956. Twelve years later at the age of 64 she was operated on for an anaplastic cancer arising in the right lobe of the thyroid. Other thyroid neoplasms following the therapeutic use of radioiodine have also been reported although the incidence may still be within the range of statistical coincidence. There is a definite risk of later malignant change after external radiation to the thyroid in infants and children. The risk in adults seems to be smaller, and the latent period is longer. The experimental and clinical evidence indicate some caution in the therapeutic use of radioiodine. (auth)

Radiation Effects on Plants

Refer also to abstracts 24530, 24561, 24597–24600, 24602, and 24603.

24763 INFLUENCE OF THE RADIOPROTECTOR AET (S,β-AMINOETHYLISOTHIURONIUM Br.HBr) ON THE GROWTH AND DEVELOPMENT OF BARLEY PLANTS AT HIGH DOSES OF γ IRRADIATION BY ^{137}Cs. Panoyan, R. E. (Inst. of General Genetics, Moscow). Radiobiologiya, 9: No. 1, 134-8 (1969). (In Russian).

The joint action of the radioprotector AET with γ radiation on the first generation (M_1) of barley plants was studied. It was found that at irradiation doses of 20, 25, and 30 kR, the survival rate and height of the plants, the total and productive bushiness are reduced, while the percentage of sterile heads and dying stems is increased. The radioprotector in concentrations of 10^{-2} M and 10^{-3} M without irradiation lowers the survival rate and bushiness, decreases the percentage of stems that died, and does not affect the remaining indices of plant growth and development (these concentrations are subtoxic). Treatment of the seeds with AET before, during, and after γ irradiation increases the survival rate, the height of the plants, the total and productive bushiness, and also lowers the percentage of sterile heads and dying stems. (JPRS)

24764 INFLUENCE OF γ IRRADIATION OF SEEDS OF VARIOUS PLANTS ON THE METABOLISM OF TYROSINE, PHENYLALANINE, AND 3,4-DIHYDROXYPHENYLALANINE IN SEEDLINGS. Fomenko, B. S.; Medvedev, A. I. (Inst. of Biological Physics, Pushchino on the Oka, USSR). Radiobiologiya, 9: No. 1, 129-33 (1969). (In Russian).

As a result of γ irradiation at a dose of 10 kR and the critical dose of broadbean, pea, kidney bean, and cotton seeds, an increase in the content of phenylalanine, tyrosine, and total amino acids was observed in the leaves of 5- to 15-day seedlings in comparison with the control. In the broadbeans there was parallel increase in the content of 3,4-dihydroxyphenylalanine. The relative increase

in the amount of amino acids in seedlings grown from irradiated seeds resulted from the more rapid decrease in their content in the control plants. In the case of irradiation of barley, sunflower, and cabbage seeds, no disturbance of the metabolism of the amino acids studied was observed. (JPRS)

24765 EFFECTS OF X RADIATION ON THE PERMEABILITY OF THE ALGA NITELLA FLEXILIS TO ^{22}Na IONS. Ozerskii, M. I. Radiobiologiya, 9: No. 1, 120-2(1969). (In Russian).

After x irradiation of the fresh water alga Nitella flexilis with a dose of 80–120 kR (dose rate 100 kR/min), an increase in the permeability to a flow of ^{22}Na within the cell was obtained. This effect of an increase in the permeability under the action of radiation disappeared if the alga was kept in a solution of $5 \cdot 10^{-5}$ M ouabain before the experiment and was preserved if it was exposed to a solution of $2 \cdot 10^{-4}$ M 2,4-dinitrophenol before the experiment. On the basis of an analysis of the experiments and the literature data, it was proposed that the recorded increase in the permeability to a flow of ^{22}Na within the cell is associated with inactivation of the sodium pump in the plasma lemma. (JPRS)

24766 BIOLOGICAL EFFECTS OF GAMMA IRRADIATION ON LICHENS AND LICHEN SYMBIONTS. Gannutz, Theodore Peter. Worcester, Mass., Clark Univ., 1968. 173p.

Thesis.

The effects of ionizing radiation on the lichen communities of an oak-pine forest and a tropical rain forest were surveyed. A 50% reduction in the number of lichen species of the oak-pine forest occurred at 2700 R/day after one year of irradiation. Species diversity of the lichens in the tropical rain forest was reduced 50% by a dose of 300 kR acute gamma irradiation. The tropical rain forest study was made three months after the completion of irradiation. Using the proper conversion between chronic and acute irradiation, the tropical rain forest lichen community was found to be more radioresistant than the oak-pine forest lichen community. Lichens are one of the more radioresistant plant communities. There are several possible reasons for their high radioresistance: lichens are composed of microorganisms which possess small nuclei; some lichen components contain large amounts of lipid; cells of some lichen components are multinucleate; lichens respond slowly to radiation due to the slow rate of cell turnover of the symbionts. Chronically irradiated specimens of Parmelia caperata, P. sulcata, and Cladonia spp. were examined over a three year period. Growth of Parmelia thalli was reduced 50% by about 100 R/day. Growth of Cladonia thalli was reduced 50% by about 300 to 400 R/day. Some chronically irradiated crustose and fruticose lichens were stimulated in growth and reproduction by radiation in the oak-pine forest. Morphological effects of ionizing radiation on foliose and fruticose lichens were similar to those of natural environmental stress. Foliose thalli demonstrated an increase in folding and density of asexual reproductive structures. The podetia of fruticose lichens were stunted and the numbers of squamules on podetia increased. Effects of ionizing radiation on growth and survival of isolated lichen components were examined. LD_{50}'s ranged from 10 to 54 kR for the lichen algae and 12 to 248 kR for the lichen fungi. Reduction in growth by 50%, however, required considerably higher radiation levels in most cases. Lichen algae, in general, were more radiosensitive than lichen fungi. Lichen algae are limiting in survival of stressed lichens. Lichen thalli are more radiosensitive than their isolated symbionts. (Diss. Abstr.)

24767 THE SURVIVAL CURVES OF HAPLOID AND DIPLOID CHLAMYDOMONAS REINHARDTII EXPOSED TO RADIATIONS OF DIFFERENT LET. Davies, D. Roy (United Kingdom Atomic Energy Authority, Wantage, Eng.); Holt, P. D.; Papworth, D. G. Int. J. Radiat. Biol., 15: 75-87(1969).

Haploid and diploid cell stages of the unicellular green algae Chlamydomonas reinhardtii were exposed to acute and fractionated doses of radiations, having LET values up to 1298 MeV g^{-1} cm^2. The shoulder region of the acute survival curves was smaller the higher the LET, the reduction being greater for the diploid than for the haploid. In no instance did the response become exponential. Recovery on dose fractionation occurred at all LET's, and the magnitude of the recovery was correlated with the size of the shoulder. The survival data were fitted better by the multi-hit single target and Haynes repair models than by the single-target single-hit or multi-target single-hit models, but there were difficulties in the application of both the first two models to provide adequate biophysical interpretations of the phenomena. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 24551, 24592–24596, 24672, 24778, and 24780.

24768 (MIT–3325-40) THE EFFECT OF REPEATED TREATMENT WITH GAMMA RAYS ON THE RADIO-RESISTANCE, VIRULENCE, AND CULTURE CHARACTERISTICS OF CERTAIN PATHOGENIC BACTERIA. Final Report. Licciardello, J. J.; Nickerson, J. T. R.; Goldblith, S. A. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nutrition and Food Science). Oct. 1968. Contract AT(30-1)-3325. 151p. Dep. CFSTI.

Several Salmonella serotypes were subjected to consecutive γ irradiation and sub-culturing treatments to determine whether mutants with increased radiation resistance, increased virulence or altered biochemical characteristics might be induced or selected that could present a threat to a potential irradiation process designed to destroy Salmonella in a food. This cyclic irradiation treatment did indeed produce cultures with increased radioresistance. The number of radiation cycles required to effect a significant change in radioresistance depended upon the irradiation dose. With a $2D_{10}$ dose a notable increase in radioresistance was apparent after about 6 irradiation cycles whereas with a $5D_{10}$ dose about 10 cyclic irradiations were necessary. These radioresistant mutants were resistant at all stages of their growth cycle and maintained their resistance after 24 transfers in broth. The virulence of radioresistant cultures (radiation-cycled) was compared with that of the parent cultures using mice or embryonated eggs as hosts. The radio-resistant cultures were not more virulent than the parent cultures and with one radioresistant serotype a decrease in virulence occurred. The irradiation treatment also did not appear to transform rough colony types (avirulent) to smooth (virulent). Cyclic irradiation did not cause a gross change in the biochemical pattern although one or two biochemical reactions of two of the serotypes were altered. With two Salmonella serotypes cyclic irradiation did not cause any perceptible alteration in serological properties although a few isolates gave a weak agglutination reaction with poly Salmonella O or H antisera. However, cyclic irradiation did appear to modify the antigenic properties of S. newport. Cyclic irradiation produced a morphological change in cell shape from slender rods to plump oval cells. This phenomenon was most pronounced with S. newport. In spite of the changes that may have occurred in biochemical properties, serology or morphology of the cultures as a result of cyclic irradiation, it was believed that these cultures would still be typed as Salmonella if one resorted to a protocol that included comprehensive biochemical and serological testing. There was no difference between growth rates of radiation-cycled cultures and the parent cultures under aerobic or anaerobic conditions over a temperature range of 10 to 45°C. Radiation-cycled cultures of Salmonella showed mixed reactions to antibiotic sensitivity. (C.O.)

24769 DEPENDENCE OF THE REMOTE EFFECT OF X RADIATION ON THE REPRODUCTION OF TOBACCO MOSAIC VIRUS IN TOBACCO LEAVES ON THE DOSE AND TIME BETWEEN IRRADIATION AND INFECTION OF THE LEAVES. Pod'yapol'skaya, T. S. (Inst. of General Genetics, Moscow). Radiobiologiya, 9: No. 1, 123-8(1969). (In Russian).

The minimum time after local irradiation of a tobacco leaf required for the manifestation of the remote effect of radiation on the replication of tobacco mosaic virus in this leaf is 4 hrs. The remote effect of radiation was detected in the dose range from 5 to 50 kR and was not detected at a dose of 100 kR. The nature of the dependence of the local and remote effects of radiation on the dose was the same. The maximum value of the remote effect of radiation is approximately two-thirds of the local effect. The remote effect of radiation is transitory for all doses of irradiation. It disappears 34 to 48 hrs after local irradiation of the leaf at a dose of 15 kR and after 72 hrs for a dose of 50 kR. (JPRS)

24770 INFLUENCE OF MUTAGENIC AGENTS ON THE INTEGRATION OF THE F EPISOME INTO THE CHROMOSOME OF ESCHERICHIA COLI K12 F^+. Rajchert-Trzpil, Mariana; Dobrzanski, W. T. (Univ. Medical School, Warsaw). J. Gen. Microbiol., 54: 47-57(Nov. 1968).

E. coli F^+ donor bacteria were treated with uv radiation, mitomycin C, nitrous acid, hydroxylamine, or caffeine, and then incubated for various periods in broth at 37° before conjugation. Ultraviolet radiation, mitomycin C, and nitrous acid increased the fertility of F^+ populations, but hydroxylamine and caffeine did not. The maximal effect of uv irradiation was obtained after using a dose of 50 to 100 erg/mm^2 and after 45-min incubation in broth of irradiated bacteria before conjugation. The maximal effect of mitomycin C occurred after treatment with 1 to 3 μg/ml and after 110-min incubation in broth. Depending on the strain used, the fertility of the population increased 8 to 20 times after uv irradiation and 5 to 21 times after mitomycin C. The effect of uv irradiation could be photoreactivated up to 50%. Following treatment of strain W 1655 with nitrous acid (0.01M), a 3 to 4-fold increase in the yield of conjugation was obtained, although irregu-

larly. Caffeine (0.01%) enhanced the effect of uv irradiation about 2-fold. Chloramphenicol blocked the expression of the effect of uv irradiation and mitomycin C. The effect of chloramphenicol was not permanent, because after its removal followed by further incubation the fertility of the F^+ population increased to the same degree as in the samples in which the bacteria, previously exposed to uv radiation or mitomycin C, were incubated in broth without chloramphenicol. (BBB)

24771 PROTOTROPHIC PROPERTIES AND X-RAY RESISTANCE OF SOME NODULE BACTERIA. Tohver, V.; Lokk, E. (Tartu State Univ., Tallin, USSR). Izv. Akad. Nauk Est. SSR, Ser. Biol., 3: 347-56(1966). (In Russian).

Nitrogen-fixing capacities, growth factors, and organic substances were studied in laboratory cultures of the following Rhizobium nodule root bacteria: R. leguminosarum (garden pea and vetch strains), R. meliloti (sweet clover and alfalfa strains), R. japonicum (soybean strains), and R. lupini (blue lupine strains). The first two, fast-growing species, were found to be more prototrophic than the last two, slowly growing species. In conjunction with this, experiments were carried out to determine the radioresistance of the four strains. At doses of 31.3 R/sec of x irradiation, all four of the parent bacteria cultures received three irradiation exposures with total doses equivalent to 0.5, 2.0, 8.0, 16.0, and 20.0 KR. The fast-growing bacteria showed considerably more resistance to x rays than the slow-growing bacterial species. While the LD_{50} for the fast-growing species was about 16 KR, 8 to 10 KR was indicated for the slowly growing group. When a 20-KR total irradiation dose was used, the survival rate of the 1st group was 45.2%, and that of the 2nd group 26.4%. Statistical data showed that a substantial positive correlation existed between the values of prototrophic properties and the resistance to ionizing irradiation in root nodule bacteria. (BBB)

24772 THE MECHANISM OF INACTIVATION OF T4 BACTERIOPHAGE BY TRITIUM DECAY. Funk, Fred (California Inst. of Tech., Pasadena); Person, Stanley; Bockrath, Richard C. Jr. Biophys. J., 8: 1037-50(Sept. 1968).

Coliphage T4 was used as a model system to study the mechanism of biological inactivation produced by tritium decay. Tritiated precursors were incorporated into phage DNA (thymidine-^{3}H) or into phage protein (^{3}H-amino acids). The ratio of killing efficiencies for decays originating in phage DNA to those originating in phage protein was 2.6. Inactivation by decays from labeled amino acids was assumed to occur exclusively from β irradiation of phage DNA. If decays originating in DNA are due solely to irradiation of DNA, then the killing efficiencies reflect the energy transfer paths in phage DNA for decays originating in phage DNA and in the protein coat. The energy transfer paths were determined for the two cases with the help of a computer and found to be nearly equal to the experimentally determined ratio (2.6). The killing efficiencies for decays originating in phage DNA were 0.12 and for decays originating in protein 0.046. (BBB)

24773 ULTRA-HIGH DOSE-RATE EFFECTS IN RADIOSENSITIVE BACTERIA. Phillips, Theodore L.; Worsnop, B. Ralph (Univ. of California, San Francisco). Int. J. Radiat. Biol., 14: 573-5(1968).

Pseudomonas fluorescens were electron irradiated at ultra-high dose rates (3×10^{10} rads/sec, pulse lengths 10 nsec to 4 μsec at 10 or 12 MeV from a linear accelerator) to find the dose level at which O_2 depletion occurs. The surviving fraction of bacteria grown on standard enriched medium) was determined in suspensions irradiated in air, N_2, and 5, 2.4, and 1% O_2, and is shown (graph) to decrease logarithmically with total dose. The decrease is most rapid in air, slowest in N_2. The curves for the low O_2 percentages are at first identical with that of air, then break sharply and parallel the N_2 curve, giving O_2 depletion levels of 4, 3, and 1.5 kilorads, respectively. P. fluorescens responds as might be predicted from chemical systems, evidently having an O_2 concentration at the sensitive site close to that in the surrounding medium. Ultra-high dose rates might be useful in radiation therapy, where there exists a problem due to the difference in sensitivity between normal oxygenated cells and anoxic tumor cells. (C.O.)

24774 EFFECT OF SALTS ON THE PROCESS OF MITOSIS IN ESCHERICHIA COLI. Ricard, Matthieu; Hirota, Yukinori (Institut Pasteur, Paris. College de France, Paris). Compt. Rend., Ser. D, 268: 1335-8(Mar. 3, 1969). (In French).

The salts yield at 40° some phenotypically normal thermosensitive mutants of E. coli, which are formed from filaments or which no longer synthesize DNA. Sodium chloride affected equally the sensitivity to uv radiation, to penicillin, and to cellular permeability. (tr-auth)

Radiosterilization and Radiopreservation

24775 (AEC-C-5-9) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. SECTION 05: RADIATION EFFECTS ON FOOD. Beising, Kurt; Kohn, Rudolf (comps.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). Oct. 1968. 54p. (In English and German). Dep.

Approximately 360 references to the literature concerning radiation effects on food are included. The references are classified as conferences, dissertations, patents, reports, journal articles, and books. Author and subject indexes are included. (H.L.W.)

24776 (BMwF-FBK-68-55) STUDIES ON RADIOSTERILIZATION OF SURGICAL APPLIANCES PARTICULARLY OF BIOLOGICAL ORIGIN. Schnell, J. (Braun (B.) Medizinisch-Pharmazeutische Werke, Melsungen (West Germany)). Dec. 1968. 59p. (In German). Dep.

Experiments on radiation sterilization of surgical appliances (especially collagen-based materials) are reported. A dosage of 2.5 Mrad gave sterility of such products. Comparative studies of physical and chemical properties and in vivo implantations of catgut, dura mater, collagen foils and bone grafts, did not show marked differences in properties of materials chemically sterilized using ethylene oxide or sterilized by gamma radiation at doses of 2.5 Mrad. (auth)

24777 (CONF-670649-33) PRESERVATION OF FOODS BY IRRADIATION. V. ECONOMIC STUDY OF THE SALE OF POTATOES IN SPAIN AND POSSIBILITIES OF THEIR PRESERVATION BY IRRADIATION. Rivas, A.; Garcia de Mateos, A.; Ortin Sune, N.; del Val Cob, M. (Junta de Energia Nuclear, Madrid (Spain)). [1966]. 37p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

A study was made of potato sales in Spain to investigate the possibilities of potato preservation by irradiation units. Statistical data on the production of potatoes with respect to regions and station are presented. An estimation was made of the usual crop losses in the last few years and the results were compared with analogous data from France. Exact data on the consumption of potatoes are not available because of the large rural consumption of potatoes that are not put on the market. However, an estimation of the monthly consumption was made. From these consumption evaluations, the most economical quantities for radiation preservation were calculated, and the most appropriate timing for the procedure was determined. (tr-auth)

24778 (TID-24880) THE SIGNIFICANCE OF CLOSTRIDIUM BOTULINUM TYPE E IN THE APPLICATION OF RADIATION-PASTEURIZATION PROCESS TO PACIFIC CRAB MEAT AND FLOUNDER. Final Summary. Eklund, M. W.; Poysky, F. T. (Bureau of Commercial Fisheries, Seattle, Wash. Technological Lab.). July 1965. Contract AT(49-7)-2442. 72p. Dep. CFSTI.

Samples of crab were examined from the coastal areas of Alaska, Washington, Oregon, and California for the presence of Clostridium botulinum. Samples grown on an enrichment medium were injected into mice. The injected mice were observed for typical symptoms of botulism and the toxin was identified by determining its heat lability and by the ability of the antitoxins Types A, B, C, E, or F to neutralize the toxic factor. The incidence of Cl. botulinum in crab was lowest in the California area. The types of Cl. botulinum from crab were mainly Type E. A total of 164 samples from crab processing plants were examined for Cl. botulinum; the organism was not demonstrated in the plants beyond the boiling tanks. Studies were made on the incidence of Cl. botulinum in live crab entering the processing plant; results indicated that cooking for 20 min in the boiling tanks destroyed Type E in whole crab. Marine mud samples were examined for the presence of Cl. botulinum. Type E was demonstrated in samples along the West Coast to 36° North Latitude. Examination of trawl fish for Cl. botulinum revealed a high incidence in rex sole from the mouth of the Columbia River. Studies were conducted on growth and toxin production of Cl. botulinum Type E in irradiated and unirradiated sole fillets in relation to spoilage time of the fillets stored at various temperatures. Effects of radiation dose on bacterial growth and production of trimethylamine and total volatile bases were also studied. (H.L.W.)

24779 (TID-24881) GROWTH AND TOXIN PRODUCTION OF CLOSTRIDIUM BOTULINUM TYPES E, NONPROTEOLYTIC B, AND F IN NONIRRADIATED AND IRRADIATED FISHERIES PRODUCTS IN THE TEMPERATURE RANGE OF 36° TO 72°F. Final Summary. Eklund, M. W.; Poysky, F. T.; Wieler, D. I. (Bureau of Commercial Fisheries, Seattle, Wash. Technological Lab.). Nov. 1967. Contract AT(49-7)-2442. 86p. Dep. CFSTI.

The results of experiments performed during the current contract year on growth and toxin production of Clostridium botulinum types E, nonproteolytic B, and F in irradiated and nonirradiated fisheries products are presented. The following experiments are included in the report: Problems of vegetative cells in nonheat-shocked type E spore inoculum produced at 10°C. The outgrowth time of Clostridium botulinum type E in irradiated and nonirradiated haddock and petrale sole fillets. The effects of glucose and ribose on the outgrowth and toxin production of type E spores in trypticase-peptone medium and in irradiated Atlantic cod and haddock fillets. The characteristics of nonproteolytic Clostridium botulinum types B and F isolated from the Pacific coast and comparison of the low-temperature outgrowth time of nonproteolytic types B and F with that of type E. (E.R.B.)

24780 (TID-24887) TREATMENT OF POULTRY WITH IONIZING RADIATIONS TO DESTROY SALMONELLAE. Licciardello, J. J.; Nickerson, J. T. R.; Goldblith, S. A. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nutrition and Food Science). Oct. 1967. Contract AT(30-1)-3727. 40p. Dep. CFSTI.

The cobalt-60 γ radiation survival curves for S. typhimurium in chicken dark meat and in chicken white meat had approximately the same slope. The D_{10} dose in these menstra was about 50,000 rad. A greater destruction of S. typhimurium was obtained in chicken menstrum by irradiating in the un-frozen state and then freezing than by first freezing and then irradiating in the frozen state. The rate of inactivation of S. typhimurium in chicken meat during irradiation increased with increasing irradiation temperature (0°F, 32°F, 70°F, 100°F and 115°F); the greatest differences were observed between 0°F and 32°F and between 100°F and 115°F. The survival curves for five salmonellae serotypes in chicken meat were determined during radiation treatment at 32°F and procedures for the isolation and identification of salmonellae from poultry were worked out; results are presented and discussed. It was concluded that irradiation treatment to reduce the number of salmonellae in poultry to a level generally considered as safe would require the application of dose levels of only about 100,000 rad and treatment with higher dose levels than this (which would have to be applied as a pasteurizing dose to extend storage life at refrigerator temperatures above freezing) would provide additional safety factors. (C.O.)

24781 STUDIES ON THE ERADICATION OF ANOPHELES PHAROENSIS BY THE STERILE-MALE TECHNIQUE USING ^{60}Co. VII. POPULATION DYNAMICS OF MOSQUITOES IN FAYOUM AREA, UAR. Abdel-Malek, A. A.; Tantawy, A. O.; Wakid, A. M. (Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo). J. Econ. Entomol., 62: 348-51 (Apr. 1969).

The population dynamics of mosquitoes present in a semiisolated area of Fayoum Province, UAR, were studied for the years 1965 to 1967 inclusive. Of seven species captured, Anopheles pharoensis Theobald; Culex pipiens L., and Aedes caspius Pallas were the most abundant. Highest densities of these three species coincided with summer hot months. It is recommended that initiation of a sterile-release program for eradication of A. pharoensis take place during late April and early May when the population is lowest and at its threshold of development. (auth)

24782 STERILIZATION BY GAMMA RAYS: THE BEGINNING OF A BIG CHANGE. Rainey, H. B. (Tasman Vaccine Lab. Ltd., Upper Hutt, N. Z.). Int. Nurs. Rev., 15: 157-63 (Apr. 1968).

The introduction of radiosterilization of medical supplies in New Zealand hospitals is described as well as its impact on nursing procedures and personnel. A Board of Health Committee, including representatives of the nursing profession, in 1962 reviewed efforts to centralize sterilization in New Zealand hospitals, complicated at that time by the advent of cheap medical disposables. It approved central sterilization, especially by radiation, and use of prepacked sterile supplies. A ^{60}Co γ-radiation plant for bulk sterilization was set up at Upper Hutt by the Tasman Vaccine Laboratory. It necessitated standardization of nationwide dressing packs. The process reduced costs by 30%. Closely linked to the growth of central sterilization was the development of disposable materials which can withstand radiation. The dose of radiation accepted as adequate, namely 2.5 Mrad, is more than sufficient to kill all and any bacteria. It will, for instance, kill staphylococci with a much higher efficiency than the standard method of heat sterilization, namely 120°C for 20 min. Irradiation plays a major role in allowing safer, cheaper, and more efficient sterilization and in eliminating much needless work in nursing care. (BBB)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstracts 24397 and 25026.

24783 (ORNL–4377) HEAVY-SECTION STEEL TECHNOLOGY PROGRAM SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING AUGUST 31, 1968. (Oak Ridge National Lab., Tenn.). Apr. 1969. Contract W-7405-eng-26. 117p. Dep. CFSTI.

The information in the report is presented in four sections. A separate abstract was prepared for each section. (F.S.)

For abstracts of individual sections see: 24810, 24860, 24861, and 24960.

24784 (ORNL–4390) FUELS AND MATERIALS DEVELOPMENT PROGRAM. Quarterly Progress Report for Period Ending December 31, 1968. Patriarca, P. (comp.); Rucker, D. J. (ed.) (Oak Ridge National Lab., Tenn.). May 1969. Contract W-7405-eng-26. 308p. Dep. CFSTI.

Information in the report is presented in sixteen sections. A separate abstract was prepared for each section. (J.R.D.)

For abstracts of individual sections see: 24408, 24793, 24811, 24812, 24862–24866, 24961, 24962, 24973, 24992, and 25021–25023.

24785 CRITICAL MATERIALS IN AN ADVANCING TECHNOLOGY. Promisel, N. E.; Lane, J. R. Technical Report No. D8-13.1. Metals Park, Ohio, American Society for Metals. 14p.

Because of the vital importance of materials to the national security and economy, the Federal Government created a list of critical and strategic materials and an accompanying stockpiling program. The genesis and nature of this program, its importance to the U. S., the government agencies involved and the government-sponsored program at the Materials Advisory Board to maintain alertness and awareness of changing situations which result from technological advances, with projections into the future was discussed. Some illustrative highlights were provided from MAB reports on Be, Mo, Ni, Pt, Ag, Ti and Ta. Probable future trends were discussed and the important role that will be played by nonmetallics, composites, synthetics and new fabrication concepts was emphasized. Attention was also given to the anticipation of new materials problems derived from current attention to social needs and situations. (Metals Abstr.)

24786 AIRBRASIVE JET MACHINING TECHNIQUES AND RELATED AJM EQUIPMENT. Kulischenko, Walter. Technical Paper No. MR68-524. Dearborn, Mich., American Society of Tool and Manufacturing Engineers, 1968. 9p.

Abrading, frosting, cleaning, polishing, microdeburring and cutting can be carried out with an airbrasive jet machining system using an aluminum oxide powder and gas propellant. Process parameter adjustments were considered, including the type of powder, flow, gas pressure, size and type of discharge nozzle and the distance from the end of the nozzle to the workpiece. The method was especially recommended for cutting W without cracking, splitting or breaking. It is widely used to correct printed circuit boards by removing faulty plating and for trimming resistors and capacitors. (Metals Abstr.)

24787 VACUUM BORIDING OF TRANSITION METALS BELONGING TO GROUPS IV, V, AND VI OF THE PERIODIC TABLE. Zhunkovskii, G. L.; Samsonov, G. V. Fiz. Khim. Obrab. Mater., No. 4, 132-40(July-Aug. 1968). (In Russian).

The conditions required for the vacuum boriding of transition metals belonging to Groups IV (Ti, Zr, Hf), V (V, Nb, Ta), and VI (Cr, Mo, W) of the Periodic Table are considered. The parabolic form of the relationship between the thickness of the boride coatings formed and the time and temperature of saturation indicate that the limiting factor is the diffusion of B through the crystal lattice of the developing phases. The diffusion zones in all the metals have columnar structure. This is attributed to the preferential growth of the developing phases in the direction of the base. The activation energy associated with the diffusion of B increases as the defectiveness of the d level in the metals become less marked and the principal quantum number increases. (Metals Abstr.)

24788 DESIGNING FOR INERTIA WELDING. Kiwalle, Jozef. Mach. Design, 40: 161-6(Nov. 7. 1968).

Carbon, sintered stainless, tool and alloy steels, Al alloys, Cu, brasses and bronzes, Mo, Waspaloy, Co, Ti, Zr alloy, Inconel, Ni alloys and dissimilar combinations such as 316 stainless to Inconel, Co-base alloys to steel, Ti to 302 stainless and Cu to medium carbon steel may be joined by inertia welding. Tests of the welds show that tension, bending, impact, fatigue tension and fatigue bending properties exceed those of the weaker parent material in most cases. Welds are free from porosity, oxides, and inclusions. Parts must be able to withstand the high torque, thrust, and gripping forces associated with the process. The ideal shape is circular but deviations can be accommodated. The sliding velocity, flywheel moment of inertia and thrust are the three variables which control the character of the weld. Illustrations show the effects of improper speed, excessive thrust or excessive energy. (Metals Abstr.)

24789 URANIUM: THE PRESENT AND THE FUTURE. Bowie, S. H. U. Ninth Commonwealth Mining and Metallurgical Congress. London, Institution of Mining and Metallurgy, 1969. 16p.

The uranium problem is discussed under the following headings: Demand; reserves and resources in the major ore fields; availability of reserves; continuity of supply; geological criteria for favorable areas; and methods of discovery and assessment. (UK)

Corrosion and Erosion

Refer also to abstracts 24145, 24886, 24975, 24976, and 25150.

24790 (AECL–3065) OXIDATION AND HYDRIDING OF ZIRCALOY IN NPD REACTOR. Bain, A. S.; Lesurf, J. E. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Jan. 1969. 35p. Dep. CFSTI. CAN $1.00.

Corrosion and hydriding which has been observed on the cladding of NPD fuel bundles related to coolant chemistry, fuel sheath material, and to power rating of the fuel bundles are examined. Desirable coolant conditions at which to operate future reactors of this type are discussed. (auth)

24791 (EUR–3476(Add.1)) SURFACE TREATMENT OF ZIRCONIUM ALLOYS WITH OXIDIZING FUSED SALTS. COMPLEMENTARY STUDY ON THE BEHAVIOR OF ZIRCALOY IN CHLORINE-CONTAINING TERPHENYL. Hardy-Grena, C. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1968. 3p. (In French). Dep.

Systematic tests were made on Zircaloy in the presence of chlorine, alone or in the presence of a carbonated compound. The evolution of the corrosion of the surface-oxidized Zircaloy can be divided into three stages. The hydration caused by the hydrogen coming from the radiopyrolysis of the terphenyl is quasi arrested by the surface oxide layer. The hydration in the presence of chlorine and in the absence of carbon is also at a very low level. The hydration in the presence of both chlorine and carbon occurs at a very high rate; the surface oxide layer is no longer a protective coating, the carbon catalyzes it, chlorination and the hydration occurs in depth in the Zircaloy. It was concluded that if the terphenyl used has > 5 ppM Cl_2, the surface oxidation treatment in a molten nitrate bath produces an effective barrier against the corrosion of Zircaloy by hydrogen. (J.S.R.)

24792 (USNRDL-TR-68-109) SEAWATER CORROSION STUDIES OF SNAP-21 MATERIALS. Kubose, D. A.; Lai, M. G.; Goya, H. A.; Cordova, H. I. (Naval Radiological Defense Lab., San Francisco, Calif.). July 21, 1968. Contract AT(49-5)-3002. 49p. Dep. CFSTI.

Corrosion rates of Hastelloy C, Hastelloy X, titanium-621, and Berylco-165 in seawater were measured at 23°C. Measurements were also made on Hastelloy C and Hastelloy X corrosion in seawater vapor at 200°C and on Hastelloy C, titanium-621, and Berylco-165 at 23°C under seawater at 7000 psi. Radiation effects tests were conducted on Hastelloy C and Hastelloy X in seawater at 30°C exposed to an ionizing radiation field of 2×10^5 r/hr. Significant increases in corrosion rate were observed only for Hastelloy C and Hastelloy X in hot seawater vapor (approximately two orders of magnitude) and for Hastelloy C in seawater under high hydrostatic pressure (approximately an order of magnitude). (auth)

24793 (ORNL–4390, pp 85-109) ALKALI–METAL CORROSION STUDIES. Harms, W. O.; DeVan, J. H.; Litman, A. P. (Oak Ridge National Lab., Tenn.).

Effects of O on the corrosion of V by Na were evaluated at 600°C in capsules of Mo and stainless steel, respectively. Exposure of V to molten Li was found to reduce the oxygen content of the V significantly without manifesting other metallurgical

changes. The nature and rate of interstitial changes produced during vacuum annealing were evaluated in pure V at 900°C. Pressures $\leq 10^{-7}$ torr are required to avoid significant changes in O and C. Oxidation test equipment for evaluating the compatibility of stainless steel and thermal insulation, with and without the presence of Na was assembled. Kinetic treatments describing mass transport in liquid metal systems were refined to include effects of solid-state diffusion. Details are presented concerning the examination of a Nb–1% Zr helical induction pump used to circulate boiling K for 10,000 hr in an experiment in a loop of D-43 alloy. The effect of O on the compatibility of Nb with K was evaluated at 600°C. The gettering-vacuum-fusion (GVF) technique for determining O in K and Na was compared against other analytical techniques. The analysis of a T-222 thermal convection loop that had circulated Li for 3000 hr at 1350°C is continuing. Insert specimens from the loop showed a loss of O at all positions and an increase in N at the coldest position. Construction continued on a T-111 forced circulation liquid lithium test bed loop (FCLLL-1), designed to gain corrosion data on new refractory alloys for cladding fuel elements in space power systems cooled with Li. (J.C.W.)

24794 (WARD-3791-30) VANADIUM ALLOY CLADDING DEVELOPMENT. Quarterly Progress Report for the Period Ending December 31, 1968. Bishop, E. C.; Nadler, R. A.; Whitlow, G. A. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Feb. 1968. Contract AT(30-1)-3791. 68p. Dep. CFSTI.

In the development of vanadium alloys for fuel cladding for service in a liquid-metal-cooled fast breeder reactor, the nuclear and economic analysis of vanadium fuel element cladding was completed, as was all melting, extrusion and tube reduction. Processing to rod and sheet was accomplished for all alloys except for 15 Cr–5 Ti–V-base alloy. Creep rupture tests at 800°C on the VANSTAR alloys were continued along with tests of vacuum effects on creep. The effects of 500-hour aging at 700 and 800°C on the hardness, mechanical properties and microstructure of VANSTAR alloys were small but some precipitation was observed. The sodium corrosion loops ran satisfactorily, the higher velocity system completed operation after 1500 hr. The corrected oxygen analysis of both systems is now <10 ppM. Unalloyed V wires were exposed in both loops for internal friction evaluation of the loop impurities. Activation energies for VANSTAR-7, VANSTAR-9 and 20-Ti-V were calculated. Chemical analyses of corroded VANSTAR-9 revealed large quantities of C, N, and O interstitials absorbed during corrosion resulted in weight gains, and reduction in the mechanical properties. (F.S.)

24795 OXIDATION RESISTANCE OF SOME STAINLESS STEELS AND NICKEL-BASED ALLOYS IN HIGH-TEMPERATURE WATER AND STEAM. Jansson, S.; Huebner, W.; Oestberg, G.; de Pourbaix, M. (Aktiebolaget Atomenergi, Stockholm). Brit. Corros. J., 4: 21-31(Jan. 1969).

Oxidation of some stainless steels and nickel-based alloys was studied to support the choice of a cladding material for the superheater elements in the Marviken nuclear reactor. The minimum Ni content was sought that would ensure sufficient resistance to high-temperature oxidation, stress corrosion, and pitting corrosion. For economy of neutrons the lowest possible Ni content was desired. Selection of cladding material for superheater reactors, including steam-cooled fast reactors, was discussed. Oxidation experiments at 500, 600, 650, 700, and 800°C in steam with different oxygen contents as well as in water at 300°C with different amounts of chloride added, were made on the following alloys, the surfaces of which had been pickled or ground: 15/15, 18/11, 20/25, 20/25 Nb, 20/35, Incoloy 800, 16/75, and 13 Cr/4A1. The oxidation resistance showed no simple relation to the alloy composition, the order between the alloys varying according to temperature and time of exposure. At steam temperatures up to 650°C ground specimens had a lower oxidation rate than did pickled specimens; at 700°C this influence of surface treatment became small for long oxidation times, and at 800°C this was true already at short times, the relation even being reversed with 18/11 and 15/15. Loss of oxide occurred in high-temperature tests. The alloys also varied with respect to the degree of grain boundary oxidation and development of local thickening of the oxide layer. The rates of erosion below 700°C and at steam pressures below 30 atm were small compared with the rate of oxidation under static conditions. (BBB)

24796 CORROSION AND PROTECTION OF URANIUM. Orman, S. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Atom, No. 150, 93-9(Apr. 1969).

A review is given of several years' work at AWRE on this subject, together with an appropriate bibliography. (UK)

24797 MECHANISMS OF OXIDATION OF Ta–10W ALLOY COATED WITH TUNGSTEN DISILICIDE. Berkowitz-Mattuck, Joan B. (Arthur D. Little, Inc., Cambridge, Mass.). J. Electrochem. Soc., 116: 700-9(May 1969).

Continuous oxygen consumption measurements were made on two commercially available W/Si type coatings, the TRW duplex coating and Solar's TNV-13, at temperatures between 1000 and 1800°C and an oxygen partial pressure of 150 torr in helium. The coatings were applied by the vendors to small cylindrical pellets of Ta-10 at. % W. It was shown that the coated samples undergo significant changes in properties if preheated in nonoxidizing atmospheres. Although the as-received TRW and TNV-13 samples were both nominally similar, they exhibited totally different oxidation behavior under the conditions investigated. Oxidation of the TNV-13 coated samples was parabolic between 1000 and 1700°C, and the parabolic rate constant increased with temperature. Oxidation of the TRW coated samples was logarithmic, and the extent of oxidation in a 1-hr time period decreased as the temperature was increased from 1000 to 1250 to 1500°C. At 1700°C, the TNV-13 coating provided protection, while the TRW coating failed catastrophically. The results of electron microprobe analysis suggested that the basic differences in oxidation mechanism between the two coating systems may be ascribed to the presence of a small amount of titanium in the TNV-13 coating. (auth)

24798 ANODIC PASSIVATION OF METALS IN FUSED SALT ELECTROLYTES. Dirmeik, Ivan Daniel. Corrosion, 25: 180-6(Apr. 1969).

The anodic polarization characteristics of titanium, nickel, several austenitic stainless steels, and plain carbon steels were investigated in various fused salt media. From voltage characteristics, it was possible to predict the propensity to corrosion or passivation. The tendency to anodically passivate the specimens was confirmed by both free exposure and anodic protection tests. This technique proved to be a suitable method for predicting corrosion behavior. It was possible to anodically passivate stainless and carbon steels in molten salts, such as ammonium acetate and sodium nitrate, which otherwise would produce severe attack in the absence of a polarizing current. (auth)

24799 EFFECT OF THE ELECTROLYTE CATION ON THE ANODIC OXIDATION OF NIOBIUM. Malygin, V. V.; Shatalov, A. Ya.; Kuchin, S. V. Elektrokhimiya, 4: 1194-6(Oct. 1968). (In Russian).

Experiments on the anodic oxidation of Nb in solutions of LiCl, NaCl, KCl, NH_4Cl, $CdCl_2$, $CoCl_2$, $NiCl_2$, and $MgCl_2$ are described. According to the results of these experiments the nature of the cation in the salt solution has a major effect on the kinetics of the oxidation process. Thus the slopes of the potential/time curves representing the oxidation rate are 0.70 for NH_4^+, 0.60 for Li^+, and 0.52 for Ni^{2+}. There is a correlation between the rate of oxidation and the ionic radius of the cation. (Metals Abstr.)

24800 AN INVESTIGATION OF THE MODE OF FAILURE OF COPPER BERYLLIUM ALLOY SPECIMENS IN STRESS CORROSION FRACTURE. Sylwestrowicz, W. D. (Bell Telephone Labs., Murray Hill, N. J.). Corrosion, 25: 168-70 (Apr. 1969).

The mode of crack propagation was investigated in specimens of a copper–beryllium alloy which had failed by stress corrosion. The investigation was done by comparing the amount of plastic deformation on the side face and on the fractured face of the specimen. The amount of plastic deformation was measured by x-ray diffraction. Results indicate that an appreciable amount of plastic deformation occurred on the fractured face during the process of fracture. The presence of additional plastic deformation at the fracture face suggest that the specimen failed by the semi-brittle propagation of a crack. (auth)

24801 STUDY OF [THE MECHANICAL AND CORROSION-RESISTANCE PROPERTIES OF] COLUMBIUM [NIOBIUM]-BASE ALLOYS. Yoda, Renpei; Babitzke, H. R.; Kato, H. Trans. Nat. Res. Inst. Metals (Tokyo), 10: No. 3, 125-41(1968).

Studies of the high-temperature strength, oxidation resistance, and ease of fabrication for a range of Nb alloys containing up to 10 alloying elements are presented. The effects of C, Al, and Cr on the precipitation hardening in these alloys were studied in detail. The Al–C precipitate is stable above 1300°C but the Cr–C precipitate dissolves at ~1150°C. Al is more effective than Ti in producing oxidation resistance. Three particular alloys are mentioned as having good oxidation resistance at 1000°C together with tensile strengths 26,000 to 32,200 lb/in^2 at 1400°C. (Metals Abstr.)

24802 OXIDATION STUDIES ON ZIRCONIUM ALLOYS IN HIGH-PRESSURE LIQUID WATER AT 360°C. Gulbransen,

E. A.; Andrew, K. F. (Westinghouse Research Labs., Pittsburgh). J. Electrochem. Soc., 116: 659-64(May 1969).

Corrosion studies were made on 22 zirconium alloys in liquid water at 360°C and 2708 psi for time periods up to 112 days. These alloys included dilute alloys of Zr with V, Cr, Ni, Fe, Sn, and Cu, intermetallic alloys of Zr with V, Cr, Ni, Fe, Sn, and Cu, intermediate alloys of Zr with V, Cr, Ni, Fe, Cu, and Zircaloy-2 and -4. Weight gain and hydrogen contents were determined. (auth)

24803 CORROSION OF REACTOR STRUCTURAL MATERIALS. Duncan, R. N. (General Electric Co., Sunnyvale, Calif.); Armijo, J. S.; Pickett, A. E. Contract AT(04-3)-189. Mater. Protect. 8: 37-8(Feb. 1969).

Two corrosion tests were conducted to determine the relative susceptibility of austenitic stainless steels and high purity alloys to grain boundary corrosion. Specimens of high purity alloys containing controlled impurity additions were tested, unstressed in a nitric acid-dichromate test (highly oxidizing acid solution), and stressed as U-bends in a high temperature (650°F) iron chloride test for up to 21 days. Manganese, silicon, nitrogen, and oxygen have little effect in either test media. Effects of silicon, carbon, and phosphorus impurities on the intergranular corrosion of high purity 14% Cr-14% Ni-balance Fe alloys are summarized. Silicon concentrations ranged from 50 to 4.1×10^4 ppM. In $HNO_3 + Cr^{+6}$, general dissolution occurred below 1000 ppM Si, and severe intergranular attack was observed between 1000 and 10,000 ppM Si. General dissolution of 4.15×10 ppM Si alloy occurred. In 650°F dilute iron chloride, alloys with less than 3000 ppM Si did not fail while alloys with more than 4000 ppM Si failed. Carbon concentrations ranged from 38 to 1480 ppM. In $HNO_3 + Cr^{+6}$, general dissolution of all alloys which were solution annealed occurred. Alloys which were sensitized displayed severe intergranular attack from 38 to 550 ppM C with slight intergranular attack of the 1480 ppM C alloy. In 650°F dilute iron chloride, no failures occurred in alloys with less than 200 ppM C. Phosphorus concentrations ranged from 15 to 950 ppM. In $HNO_3 + Cr^{+6}$, there was severe intergranular attack at 100 ppM P and higher concentrations. No intergranular attack of the 15 ppM P alloy was observed. In 650°F dilute iron chloride, no failures occurred in alloys with less than 230 ppM. (BBB)

24804 ELECTROLYTIC HYDROGEN CHARGING IN NIOBIUM SINGLE CRYSTALS. Sasaki, Yasuo; Amano, Muneyuki. Trans. Nat. Res. Inst. Metals (Tokyo), 10: No. 3, 153-4(1968).

A technique for introducing H into Nb single crystals while keeping the N and O levels below 20 ppM is described. It involves charging the specimen using a Pt anode in a 0.2N-H_2SO_4 solution at 40°C with a current density of 0.1A cm^{-2}. With this treatment for 10 hr the surface is NbH while the core has no significant H content. In the intermediate region plates of NbH intersect within the Nb matrix. (Metals Abstr.)

24805 ELECTRON MICROSCOPE AS A CORROSION RESEARCH TOOL. Grauer, R. Werkst. Korros., 19: 848-54 (Oct. 1968). (In German).

The electron microscope is used in the examination of corrosion products by electron diffraction, preparation of surface replicas, and direct irradiation of thin sections. Limitations of the method include factors such as changes in the specimen during preparation or by the action of the electron beam. Descriptions of the technique as used in studying the oxidation of Fe, the corrosion of Zn in bicarbonate solutions, and the passivation of Pb in concentrated H_2SO_4 are given. (Metals Abstr.)

24806 OXYGEN EFFECTS IN A TYPE 316 STAINLESS STEEL, Nb-1 PERCENT Zr, LIQUID POTASSIUM SYSTEM. Goldman, Kurt; McKee, John M. (United Nuclear Corp., Elmsford, N. Y.). Nucl. Appl., 6: 321-31(Apr. 1969).

Liquid potassium was circulated at 1200 to 1600°F in 31 type-316 stainless steel thermal convection loops and one forced circulation loop. Each loop contained a string of niobium-1% zirconium (Nb-1% Zr) alloy and stainless steel test specimens positioned along the entire heated leg. To follow corrosion as a function of time and temperature, the test specimens were examined at 500 to 2500 hr intervals. Controlled additions of interstitial impurities to the potassium were made in some thermal convection loops at the start of the test. Oxygen additions to the potassium sharply accelerated the initial rate of Nb-1% Zr surface removal but produced no identifiable oxide film or microstructural changes. The initially high weight-loss rates, observed in oxygen addition loops, decayed rapidly with time, returning essentially to normal rates (in the absence of further oxygen additions) after 2500 hrs. Oxygen additions produced very little effect on the stainless steel corrosion rates, presumably due to rapid gettering of the added oxygen by the Nb-1% Zr. Similar tests in a forced circulation loop, with potassium velocities past the test specimens 18 times higher than in the thermal convection loops, showed that any effects of velocity on the Nb-1% Zr corrosion rate were far overshadowed by effects that are assumed to be related to oxygen in the potassium. (auth)

24807 OXIDATION OF TUNGSTEN AT ROOM TEMPERATURE. Rybalko, V. F.; Kolot, V. Ya.; Fogel, Ya. M. (Physico-technical Inst., Kharkov). Sov. Phys.-Solid State (Engl. Transl.), 10: 2518-19(Apr. 1969).

Translated from Fiz. Tver. Tela, 10: 3176-8(Oct. 1968).

The room-temperature oxidation of tungsten metal was studied by the ion-ion emission method, using a 4-keV Ar^+ ion primary beam. The mass spectra of the secondary ions showed the presence of tungsten oxide ions. The time dependence of the ion beam current showed that the equilibrium coating of surface of the W strip is achieved over relatively long time intervals. It is concluded that oxidation of tungsten does occur at room temperature. (D.L.C.)

Preparation and Fabrication

Refer also to abstracts 24144, 24356, 24373, 24389, 24842, 24898, 24900, 24983, and 26002.

24808 (BARC-380) EXTRACTION OF TUNGSTEN FROM WOLFRAMITE. Gokhale, Y. W.; Gupta, S. S. (Bhabha Atomic Research Centre, Bombay (India)). 1968. 7p. Dep. CFSTI.

Processes for the extraction of tungsten from wolframite by alkali-leaching and carbonate-sintering have been re-examined to evaluate their relative merits, especially with regard to the silica content of the tungstic oxide. It was found that the carbonate-sintering method not only gives the product of required purity but also high recoveries. (auth)

24809 (NP-tr-1749) PLUTONIUM PRODUCTION AND USE IN THE EURATOM COUNTRIES, GREAT BRITAIN AND THE U.S.A. Meyer, P. J.; Ziegler, A. Translated by C. Mihaly (Victoria State Electricity Commission, Melbourne, Australia), from Atomwirt., Atomtech., 13: 85-90(1968). 19p. Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 28729.

24810 (ORNL-4377, pp 1-12) PROGRAM ADMINISTRATION AND PROCUREMENT. (Oak Ridge National Lab., Tenn.).

The fabrication and heat treatment of the third and fourth HSST plates are described. Sections were rerolled to 4 in. and 8 in. gage. Thermocouples were used to record austenitizing, quenching, and tempering data. The thinner plates met impact and/or drop weight requirements. The plates were inspected by ultrasonic longitudinal and shear wave techniques. Ten foot long arc welds were fabricated and inspected. (F.S.)

24811 (ORNL-4390, pp 34-57) DEVELOPMENT OF HIGH-PERFORMANCE LMFBR FUELS. Patriarca, P.; Scott, J. L. (Oak Ridge National Lab., Tenn.).

The facility for fabricating (U,Pu)N pellets by either hot or cold pressing and sintering was placed in operation. Typical contamination levels in the glove box atmosphere are 8 ppM moisture and 12 ppM O. The relationships between lattice parameter and composition were established for V(C,N) solid solutions. These data are a prerequisite to the study of the compatibility of (U,Pu)(C,N) with claddings of vanadium alloys. (auth)

24812 (ORNL-4390, pp 223-70) DEVELOPMENT OF FUEL ELEMENT FABRICATION. Adamson, G. M. Jr. (Oak Ridge National Lab., Tenn.).

High-speed movies of the deformation of simulated fuel plates during rolling confirmed previous theories on the importance of matching the mechanical properties of the core and frame materials. Factors such as billet thickness, roll diameter, reduction per pass, core fit, and roll friction affect dogboning. Fuel plates with Advanced Test Reactor (ATR) geometry were fabricated to demonstrate that dogboning can be reduced in actual fuel plates. Doubling the core thickness in plate 19 greatly reduced the dogboning. The use of a type 2219 aluminum insert at the core ends offered some improvement. In miniature fuel plates with burned oxide fuel, the degree of dogboning and void concentration both increased when weaker cladding materials were used. It has been shown that irradiation performance of such plates is a function of as-fabricated void concentration. The use of roll crushers in the comminuting of UAl_3 continues to yield improved fuel recoveries. While all parameters are not yet understood and unexplained variations in quality occur, it is shown possible to roll bond type 6061 aluminum to itself. Anodic coatings formed on type 6061

aluminum in a bath containing $TiO(KC_2O_3)_2$ plus citric and oxalic acids failed when exposed in a corrosion loop with a high heat flux across the sample. Mechanical property data were determined on the effect of oxide content and alloy additions (including Mg, Fe, Mo, Zr, Ti, and Cr) to Al. Considerable increase was found in strength (for some alloys, up to 50% at 450°C) at all temperatures with some improvement in high-temperature ductility in all alloys with oxide contents similar to those of the usual sintered-aluminum-product alloys. Miniature test plates are being successfully irradiated in the Experimental Test Reactor (ETR). Both standard and instrumented miniature plates have been fabricated with nickel coatings on the surface for use in future loadings. (J.C.W.)

24813 (RMI-12) SEMIANNUAL PROGRESS SUMMARY, JULY-DECEMBER 1968. (Reactive Metals, Inc., Ashtabula, Ohio). Feb. 21, 1969. Contract AT(30-1)-1405. 37p. Dep. CFSTI.

The operating parameters needed to produce upset-forge Co-extrusion billets to specifications have been established. A 360 ton horizontal extrusion press has been obtained and installed in the laboratory. Natural, thermal, and chemical methods to oxidize the surface of a machined U billet were examined. The chemical method improves the quality of the as-extruded or as-forged U surfaces. Tests on reduction of machining overstock left on the OD and ID have been conducted on the Mark 30A, C, and D sizes. Development of a precision extrusion process for the Mark 30A and B sizes is proceeding on schedule. (J.C.W.)

24814 (UCRL-50603) REFRACTORY ALLOY DEVELOPMENT FOR THE ADVANCED SPACE POWER REACTOR PROGRAM. Roberts, L. W. Jr.; Root, G. S. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 17, 1969. 16p. Dep. CFSTI.

The deformation of W, Re, and W-Re alloys at high temperatures was characterized and a basis was found for developing stronger alloys. A chemical-vapor-deposition process was invented for making W-Re tubing with good mechanical properties. Surface contamination of tungsten particles was found to be the obstacle to the incorporation of submicron and second-phase particles in a tungsten matrix. State-of-the-art tungsten-alloy technology was found wanting but amenable to improvement. Welding or bonding T-111 alloy to W-Re-Mo was unsuccessful. Techniques were created to study corrosion of tungsten alloys by lithium. A seven-unit facility for tensile creep testing at 10^{-10} torr at elevated temperatures was established. (auth)

24815 WELDING TECHNIQUES IN THE FABRICATION OF FUEL RODS. Schneider, G. (Nuklear-Chemie und-Metallurgie GmbH, Wolfgang, Ger.). Kerntechnik, 11: 18-25(Jan. 1969). (In German and English).

The requirements for weld joints which must be satisfied in the fabrication of fuel rods, and the present state of development and application of magnetic force resistance welding, electron beam welding and arc (TIG) welding are described. The latter, being the most widely used fuel rod welding method, is discussed in detail together with the particular conditions governing the sealing of fuel rods with zircaloy and stainless steel jackets. (auth)

24816 VACUUM DISTILLATION OF CADMIUM. Klofac, Josef. Hutn. Listy, 23: 578-80(Aug. 1968). (In Czech).

Vacuum distillation process for high-purity Cd production was discussed from the theoretical and technological points of view. The molecular distillation rate was expressed in the Langmuir-Knudsen equation. Graphitic and glass condensers were compared. The vacuum distillation equipment could produce 99.9999% pure Cd. This process involved a minimum contamination of the refined Cd and a relatively high production rate. (Metals Abstr.)

24817 PRODUCTION OF FERROALLOYS IN CZECHOSLOVAKIA. Kopca, Milan. Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove, 13: 111-17(1967). (In Slovak).

The history and the level of Czechoslovak ferroalloy production are discussed. The quality, economy, and technical parameters of ferro-Si, -Cr, -Mn, and -W production (70% electro-thermal) are said to reach the best standard. (Metals Abstr.)

24818 REAL AND PROSPECTIVE APPLICATIONS FOR BERYLLIUM. Terry, Emory. Technical Report No. GG8-10.2. Metals Park, Ohio, American Society for Metals. 21p.

The production of Be and its application in the missile, space and weapons industry as well as in aviation, for example, for aircraft disk brakes and rudders were reviewed. Potential uses for Be were also discussed and data were given on specific heat, thermal conductivity and heat sink properties of Be, Al, Mg, Ti, Cu and steels. (Metals Abstr.)

24819 POWDER METALLURGY. Joyce, J. F. DMIC Rev., 3p.(Nov. 1, 1968).

A report was given on closed die forging of preforms made from such difficult-to-forge alloys as B-1900, MAR-M200, TD Ni-high thoria (10 ThO_2) and TD Ni-Cr. The best forgeability was experienced with slip-cast billets using -200 mesh particles of B-1900 superalloy. A final report was issued on the feasibility of using the Flash Drying Selective Reduction Process to make Co-base oxidation resistant dispersion strengthened alloys with an average particle size of <0.1 micron. Another program is described in which an oxidation resistant oxide-strengthened Ni-20Cr-2ThO_2 alloy was developed. Thermomechanical processing and mechanical properties of the alloy were studied. Other developments included in the review were an exploratory investigation to determine the feasibility of preparing relatively pure Cr and Ni powders of ultrafine particle size, suitable for dispersion strengthening, by reduction of the metal oxides, with vapors of reactive metals (Mg and Li) and some theoretical aspects of compacting powders. (Metals Abstr.)

24820 CNEN'S ACTIVITIES AND FACILITIES FOR THE PLUTONIUM UTILIZATION. Schileo, Giancarlo (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz, 15: No. 2, 61-6(Feb. 1969). (In Italian).

A summary of the activities which CNEN has undertaken and is promoting in preparation for the future use of plutonium as a secondary nuclear fuel is given. The facilities and experience which CNEN has been building up in the last few years, in order that, when the time comes, the Italian industry will possess a mature technology, capable of meeting market requirements for nuclear fuels containing plutonium is described. (auth)

24821 FORMING BALLS FROM POWDER. Sirianni, Aurelio Frederick; Puddington, Ira Edwin (to Canadian Patents and Development Ltd.). British Patent 1,148,794. Apr. 16, 1969. Filed May 19, 1967.

A process is described by which finely divided metallic or other sinterable material may be formed into spheres or similar rounded shapes in a simple and economic manner, the shapes being of accurately controlled size, size distribution and shape. The finely divided material, together with an immiscible liquid, is added to an inert liquid in such quantities as to provide a three-phase system; the immiscible liquid should have a preferential affinity for the powder. The three-phase system is subjected to shaking action so as to form dispersed agglomerates of the powder and inert liquid, and so as to undergo continuous impact and ricocheting action against the rounded surfaces of the shaking apparatus, followed by separation of the shapes from the immiscible liquid. Suitable materials to which the process may be applied include metals, and refractory metal compounds such as carbides, borides, nitrides, oxides and silicides, including those of Zr, Mo, W, and U. Binder metals may be present in small amounts, and organic polymers are also suitable binder materials. The resulting shapes, among other uses, may be employed for forming pellets of nuclear fuel. Details are given regarding size of shapes, liquids employed, dispersion techniques, shaking apparatus and action, and many examples are given of applications of the process. The inert liquid may be in the frozen state and dispersion to form the three-phase system effected by warming. An emulsion of the two liquids may also be employed. Dispersing agents such as propyl alcohol may be used. The original powder may be provided with a temporary protective coating such as wax. Seed shapes may be employed. The immiscible liquid may be organic and the inert liquid may be aqueous. (UK)

24822 BERYLLIUM. Pinto, N. P.; Greenspan, J. (Beryllium Corp., Reading, Pa. Army Materials Research Agency, Watertown, Mass.). Mod. Mater., Advan. Develop. Appl., 6: 319-72(1968).

A comprehensive discussion of beryllium is given which includes details on its sources and recovery, properties, fabrication methods, costs, and the applications of Be, BeO_2, and Be alloys for aerospace structures, guidance components, and nuclear equipment. (L.C.L.)

24823 PRODUCTION OF NIOBIUM AND TANTALUM BY MELT ELECTROLYSIS. Rockenbauer, W. (Ciba AG, Basel). Chem.-Ing.-Tech., 41: 159-62(Feb. 1969). (In German).

The production of niobium and tantalum by electrolysis of the pure pentachlorides in a KF/KCl/NaCl carrier melt offered considerable advantages over the melt electrolysis of oxygen-containing systems or of systems containing double fluorides with regard to the purity of the metals obtained and the simplicity of the process. (auth)

24824 FORGING OFFSETS COMPETITIVE BLOW. Wakefield, B. D.; Obrzut, J. J. Iron Age, 202: No. 16, 69-73(Oct. 17, 1968).

Reports indicate that only Japan has shown an increased produc-

tion from 1965 to 1968 and that the forging industry, in general, is down. Automation of forge shops is a prospect for the near future and productivity is increased by using cast forging dies. Forging of new alloys for the aerospace industry is discussed. Forgings of Ti-6Al-2Sn-4Zr-2Mo, RMI 56-21S, IMI 684 and 685 and other Ti-base alloys meet tough aerospace requirements but new precipitation hardening Ni-base alloys may challenge these Ti alloys. Impression die forgings are used in underwater vehicles. Titanium-base alloys and Hy steels are candidates for use in deep submergence rescue vessels. (Metals Abstr.)

24825 IMPROVEMENTS IN OR RELATING TO THE AFTER-COMPACTION OF POROUS LAYERS. (to Siemens-Schuckertwerke Aktiengesellschaft). British Patent 1,149,390. Apr. 23, 1969. Priority date Oct. 9, 1965, Germany.

A process for filling surface pores in layers on metallic or ceramic substrates is described. The pores are filled by pyrolytic deposition of a thermally decomposable material in the vapor phase. The materials are preferably similar in their final state. An example of process application is filling the pores in a substrate using decomposing tungsten hexacarbonyl. (F.S.)

24826 DIE MODIFICATIONS CONTROL SPRINGBACK IN BENDING. van der Burgt, J. H. G. Tool Mfg. Eng., 61: No. 4, 26-7(Oct, 1968).

When forming metal parts by bending, the final shape of the product depends upon the degree of springback that occurs. This springback—the natural tendency of the material to reassume its original shape after bending—varies greatly, and is determined largely by material hardness and by the bending radius. General design considerations are discussed and illustrated for V- and U-shaped dies used to bend Al alloys and Mo. Die modifications shown include the addition of press edges, making the bender concave and rounding the edges. (Metal Abstr.)

24827 ADVANCES IN BRONZE AND COPPER ALLOY FOUNDRY TECHNOLOGY. Koumani, Georges. Rame, 6: No. 23, 39-55(Sept. 1968). (In Italian).

Methods of casting Sn-bronzes are discussed and the relative soundness and properties obtainable by sand, gravity die, pressure die, and centrifugal casting are compared. Calculation of optimum rotational speed in centrifugal casting is described. Continuous and semicontinuous casting is discussed. Foundry procedures for high-conductivity alloys, including Cu–Cr, Cu–Be, Cu–Co–Be, and Cu–Ni–Si, are described. (Metals Abstr.)

24828 ESTIMATING THE ENERGY CONDITIONS LEADING TO THE ATTACHMENT OF MOLTEN PARTICLES TO A SOLID SURFACE [AS EXISTING DURING VAPOR DEPOSITION]. Kudinov, V. V.; Rykalin, N. N.; Shorshorov, M. Kh. Fiz. Khim. obrab. Mater., No. 4, 51-8(July-Aug. 1968). (In Russian).

The processes taking place between fine particles of vacuum-evaporated metals and solid metal substrates in the course of deposition are discussed on the basis of experiments carried out with Ag, Cu, Fe, Al, Y, W, and Mo. Special attention is paid to the conditions under which a firm joint may be established between the incident particles and the underlying surface. Of particular importance in this connection is the transition from purely physical to chemical interaction between the particles and the surface. In general, the activation energy of the process of particle attachment equals half the energy of sublimation of the atoms characterizing the metallic substrate. (Metals Abstr.)

24829 IRIDIUM ALLOY. Betteridge, Walter. (to International Nickel Company, Inc.). U. S. Patent 3,429,698. Feb. 25, 1969. Priority date Aug. 12, 1965, Great Britain.

A new wrought iridium-base alloy containing 0.1 to 2% niobium is described. The presence of niobium in the iridium-base alloy resulted in an increase in the recrystallization temperature from 800°C for commercially pure iridium to a minimum of 1100°C for the alloy. Values of the tensile strength and hardness for several alloy compositions are given. An especially good combination of weldability, workability, strength, and high recrystallization temperature was obtained for the iridium alloy containing 0.75 to 1.5% niobium. The niobium–iridium-base alloy could be produced in the form of sheet, strip, rod, and wire, which could be used for making crucibles, springs, and electrodes for sparking plugs and similar devices for use at high temperature. (G.M.C.)

24830 PRESSING AND SINTERING OF CARBONYL MOLYBDENUM POWDERS. Aleshina, N. I.; Khamarmer, S. I.; Verblovskii, A. M.; Krichevskaya, O. D.; Leshchinskaya, G. P. (Leningrad Inst. of Gipronikel). Porosh. Met., Akad. Nauk Ukr. SSR, No. 3, 86-9(Mar. 1969). (In Russian).

Properties of carbonyl molybdenum powders are discussed. Carbonyl molybdenum powders possess a developed specific surface (0.6 to 1.8 m^2/g) which serves to condition their high activity at sintering. Conditions are discussed for producing sufficiently resistant raw pressed blanks of carbonyl molybdenum powders (with introduction of plasticizer or with preliminary thermal treatment) at 3 to 5 t/cm^2. Carbonyl molybdenum powders sinter effectively at 1200 to 1400°C. (auth)

24831 PURIFICATION OF CONTAMINATED GROUP IV: A REFRACTORY METAL PRODUCTS. (to Oregon Metallurgical Corp.). British Patent 1,148,460. Apr. 10, 1969. Priority date July 26, 1966, United States.

A purification method is given for hafnium, titanium, and zirconium. The impurities are melted at a temperature below the melting point of the reactive metal, vaporized, mixed with inert gas and solidified, melted again, and drained off in liquid form. The procedure for purifying titanium is given as an example. (J.C.W.)

24832 ROLLING THIN STRIP AND FOIL. Wiesner, Frantisek. Hutn. Listy, 23: 805-8(Nov. 1968). (In Czech).

The production of thin strips of Cu–Be, Ni–Fe–Mo, and Mo to precise dimensions in the range 0.018 to 0.30 mm is described. The rolling conditions and designs of rolling units employed, are mentioned. A minimum strip thickness 0.008 ± 0.003 mm was achieved. (Metals Abstr.)

24833 MANUFACTURE INCLUDING PURIFICATION OF REACTIVE METALS. (to Oregon Metallurgical Corp.). British Patent 1,148,459. Apr. 10, 1969. Priority date July 26, 1966, United States.

A production method is given for titanium. Titanium tetrachloride is reduced by magnesium, potassium, or sodium. The method also applies to hafnium and zirconium. Purification method and apparatus are described. (J.C.W.)

24834 METHODS OF CLADDING A METAL SURFACE. (to Atomic Energy of Canada Ltd.). British Patent 1,148,972. Apr. 16, 1969. Priority date Mar. 21, 1966, Canada.

A method is given of cladding a Zr alloy surface with Al at 950°F. The hot stretched aluminum is forced against the surface of the hot Zr alloy tube. The method may be applied to zircaloy-2, zircaloy-4, and to other zirconium alloys developed for use in nuclear reactor structures. (J.C.W.)

24835 COBALT SUPERALLOYS. IV. CASTING OF COBALT-BASE SUPERALLOYS. Woulds, Michael J. (Martin Metals, [Baltimore, Md.]). Metals Eng. Quart., 9: No. 2, 42-5 (May 1969).

Casting variables of cobalt-base superalloys from the master melt practice through the remelt practice are summarized. The effect of varying casting parameters on the ultimate mechanical properties was studied. Using MAR-M 509, the effect of grain size on mechanical properties, mold reactivity, and the feasibility of air melting were determined. (F.S.)

24836 WET GRINDING OF ZIRCONIUM DIOXIDE. Spicak, K. Silikaty, 12: No. 2, 113(1968). (In Czech).

Vibration grinding of ZrO_2 in plain water, with an addition of urotropine and of ammonia was investigated. Ammonia has a considerable effect on the specific surface attained after 300 min of grinding as determined by N_2 absorption. However, the specific surface determined by sedimentation increases at a much slower rate. These differences can be explained by agglomeration which accompanies all fine-grinding processes. The sedimentation results indicate a simultaneous increase in the content of sub-micron fractions and of >20 μm particles. The increment of Fe after 300 min of grinding is smaller when using an addition of NH_4OH than when the grinding is performed in plain water. (Brit. Ceram. Abstr.)

Properties Evaluations

Refer also to abstracts 24144, 24344, 24345, 24350, 24409, 24411, 24794, 24801, 24814, 24822, 24829, 24835, 24941, 24960, 26037, 26038, 26061, 26078, and 26081.

24837 (BARC-367) INFLUENCE OF TEXTURE ON THE MECHANICAL PROPERTIES OF ZIRCALOY-2 CONTAINING STRESS-ORIENTED HYDRIDES. Sinha, T. K.; Arunachalam, V. S. (Bhabha Atomic Research Centre, Bombay (India)). 1968. 19p. Dep.

The influence of stress-oriented hydrides on the tensile properties of Zircaloy-2 under varying textures is discussed. Results of room temperature tensile tests show that there is reduction in strength and ductility of Zircaloy-2 when hydrides are oriented perpendicular to stress axis; this reduction is more drastic in the

case of specimens having high basal pole density along the stress axis compared to specimens having prism texture. An interpretation based on the availability of habit planes suitably oriented along the intergranular boundaries, is advanced to explain the loss in ductility. The role of intragranular hydrides during stress-orientation has also been considered. (auth)

24838 (BARC–373) INFLUENCE OF INTERSTITIALS ON THE MECHANICAL PROPERTIES OF GROUP IV b METALS. Rodriguez, P.; Arunachalam, V. S. (Bhabha Atomic Research Centre, Bombay (India)). 1968. 31p. Dep.

These elements are able to accommodate H, C, O, and N in their large interstices making possible drastic alterations in their mechanical and physical properties. Discussions of interstice geometry, lattice parameter changes, and mechanical properties are included. Properties of alloys containing hydrogen are given special attention. (J.R.D.)

24839 (BNWL–870, pp 7.1-10) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Beeston, J. M.; Brinkman, C. R. (Idaho Nuclear Corp., Idaho Falls).

CRACKS — growth of hydrogen-induced, in unirradiated Type A542 steel
HYDROGEN — effects on cracking and embrittlement of unirradiated Type A542 steel
— effects on tensile properties of unirradiated Type A302B steel
STEEL — cracking and embrittlement of Type A542, effects of hydrogen on
— tensile properties of Type A302B, effects of hydrogen on (L.C.L.)

24840 (BNWL–870, pp 13.1-18) FRACTURE MECHANICS EVALUATION OF REACTOR VESSEL STEELS. Mager, T. R.; Thomas, F. O.; Hazelton, W. S. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.).

PRESSURE VESSELS — steel for, pre-irradiation tensile properties of Type A533B 12 in. thick plate
STEEL — tensile properties of Type A533B 12 in. thick plate, at −250 to 600°F
— fracture toughness of 12 in. thick Type A533B, at zero to −250°F
— Charpy-V notch impact data for Types A302B, A533B, and European Forging Grade, postirradiation (L.C.L.)

24841 (CONF-681031–3) ATHERMAL SOLID SOLUTION STRENGTHENING IN NIOBIUM–TUNGSTEN SINGLE CRYSTALS. Koss, Donald A. (Pratt and Whitney Aircraft, Middletown, Conn.). Dec. 1968. 52p.

From Fall Meeting of the Metallurgical Society of the AIME, Detroit, Mich.

The athermal component of the flow stress has been measured in single crystals of pure Nb and four solution strengthened Nb–W alloys (1, 3, 6, and 15 atomic percent). The magnitude of the athermal stress was obtained by the temperature dependence of the flow stress method and by a stress relaxation technique. Both methods give similar results and show that athermal substitutional solution hardening accounts for about 30 to 40% of the flow stress at 2% shear strain. Strengthening is a linear function of atomic fraction of tungsten from Nb-1 at. % W to Nb-15 at. % W; however, a more rapid rate of hardening exists between pure Nb and Nb-1 at. % W. The solute concentration dependence of the hardening can be best explained for the entire range of compositions by the Suzuki model of solution strengthening. This model predicts a $C^{\frac{1}{2}}$ dependence at small concentrations (for example, at 0 to 1 at. % tungsten) and a linear concentration dependence at higher solute concentrations. Stress relaxation measurements show that the long range athermal stress increases with strain as the crystals work harden. The dislocation velocity exponent, m*, is also obtained from both stress relaxation and strain rate change methods; the results show m* to increase with increasing atomic fraction of tungsten. (auth)

24842 (DAC–60777) PLUTONIA/CURIA COMPATIBILITY TESTING. Quarterly Report No. 1. Watrous, J. D. (McDonnell Astronautics Co., Richland, Wash. Donald W. Douglas Labs.). Jan. 1969. Contract AT(45-1)-2138. 17p. Dep. CFSTI.

Safe use of radioisotope fuels requires knowledge of the capability of materials to contain the fuel. Five refractory metals and alloys (W, Mo, Re, Mo–50 Re, and W–30 Mo–30 Re) were procured for compatibility testing. Capsules were machined radiographed, helium leak-checked, and dye-penetrant examined. Plutonia-238 pellets were cold-pressed, vacuum-sintered and loaded into molybdenum capsules which were electron-beam welded without any external contamination. (auth)

24843 (EUR–4202) CODE DIFHYD: METHOD FOR THE CALCULATION OF HYDROGEN DIFFUSION IN A FINNED LINER TUBE OF ZIRCONIUM ALLOY. Jamet, M. F.; Lecloux, M. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Nov. 1968. 100p. (In French). Dep.

DIFHYD is a code for the parametric study of hydrogen diffusion in finned zirconium liner tubes. The calculation based on the method of finite differences gives the temperature distribution in the assembly of liner tube, gas insulation and calandria tube as function of the organic and heavy water temperatures. The distribution of hydrogen concentrations, taking into account the temperature and the flow of hydrogen entering the surface of the liner tube and supposing that the limit of hydrogen solubility in Zr is reached at the tips of the fins is also determined. (tr-auth)

24844 (EUR–4207) THEORETICAL STUDY OF THE DIFFUSION OF HYDROGEN IN A ZIRCONIUM ALLOY LINER TUBE: HYDROGEN SINKS AND EFFECT OF JOINTS. Huber, B.; Jamet, M. F. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Dec. 1968. 38p. (In French). Dep.

The extraction of the hydrogen originating from the corrosion of channel liner tubes in organic coolants by means of fins welded to the outside of the tube acting as hydrogen sinks, is studied. The distributions of temperature and hydrogen concentration are calculated with the code DIFHYD. A parametrical study and the design of hydrogen sinks for the channel of the ORGEL Prototype are given. The propagation along the liner tube of the hydrogen absorbed at the zirconium alloy/steel joints is calculated. (tr-auth)

24845 (GEMP–672) PHYSICO-CHEMICAL STUDIES OF Fe–Cr–Al-CLAD FUEL SYSTEMS. Bohlander, K. M.; Edwards, H. S. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.). Sept. 1968. Contract AT(40-1)-2847. 53p. Dep. CFSTI.

Evidence is presented which supports the assumption that aluminum diffuses from clad to core and partially reduces UO_2, and that the freed uranium diffuses to the surface. Capsules containing no Al showed no surface U after 1000 hours at 1200°C. No definite relationship was determined between Al concentration in the clad (in the range 4 to 10 wt %) and the amount of surface U found. Oxygen liberated during the reduction of UO_2 forms an Al_2O_3 barrier at the cladding-core interface. This stable compound inhibits subsequent diffusion of Al into the UO_2-containing core and consequently limits the quantity of U formed. Diffusion barriers of Cr between clad and Cr–UO_2 cermet cores have the more desirable effect of inhibiting diffusion of Al into the fuel from the start of the test. When cores were fabricated from $UO_{1.989}$ (that is, a composition containing $UO_{2.00}$ plus free U) neither Cr nor Al_2O_3 barriers were effective in preventing outward diffusion of U which was present at the start of a test. Diffusion coefficients for Fe, Cr, and Al in the Fe–Cr–Al alloys are approximately 10^{-10} cm²/sec. (auth)

24846 (GEMP–1008) AEC FUELS AND MATERIALS DEVELOPMENT PROGRAM. Progress Report No. 76. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.). Sept. 30, 1968. Contract AT(40-1)-2847. 287p. Dep. CFSTI.

Information in the report is presented in ten sections. A separate abstract was prepared for each section. (J.C.W.)

For abstracts of individual sections see: 24847–24854, and 24958–24959.

24847 (GEMP–1008, pp 13-49) PHYSICAL AND MECHANICAL PROPERTIES OF REACTOR MATERIALS. Conway, J. B.; Flagella, P. N. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.).

Creep-rupture tests of unalloyed molybdenum sheet in argon at 650 and 750°C showed arc-cast material to be more creep resistant than powder-metallurgy material; elongation at rupture was in the 1 to 5 percent range for both materials. The same materials tested in the recrystallized form at 650 and 750°C showed significant strength reduction and higher ductility. Strain on loading at 750°C and 15.5 kg/mm² was about 5 percent. Tests at 1200°C in hydrogen showed that the powder-metallurgy material had a lower creep rate and greater rupture life than arc-cast sheet; stress dependence for both materials was the same. Creep-rupture data for powder-metallurgy, unalloyed rhenium sheet showed various results at 1600 and 2200°C. Ductility data for rhenium based on the elongation at rupture for creep-rupture tests at 1600 to 2800°C showed a maximum in the region of 2200°C. Thermal conductivity data for rhenium from 900 to 2500°C show a positive temperature coefficient. Electric resistivity measurements of 304L stainless steel were made from room temperature to 1400°C. The data are used to understand the thermal conductivity behavior over the temperature range indicated. (J.C.W.)

24848 (GEMP–1008, pp 115-41) ADVANCED FAST BREEDER REACTOR FUEL ELEMENT CLADDING DEVELOPMENT. Frank,

R. G.; Tarr, C. O. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.).

Molybdenum processing procedures for obtaining nuclear-quality LMFBR fuel cladding tubing are being explored and evaluated in all phases of technology from powder preparation through drawing procedures. Similarly, thermocouple tubular sheathing in unalloyed Re metal and W–25 Re–30 Mo and W–25 Re alloys were processed for inclusion in an early fast flux inpile experiment. Many tubular and sheet specimens were processed for fuel cladding studies. Preliminary phases of the work required in obtaining W–0.50s thermocouple wires were completed and fabrication studies of W–25 Re alloy in forms suited to the high-temperature elements are well advanced. (J.C.W.)

24849 (GEMP–1008, pp 143-54) PHYSICAL METALLURGY OF FAST BREEDER REACTOR CLADDING MATERIALS AND REFRACTORY METALS. Collins, C. G.; Bohlander, K. M. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.).

A study of variables influencing the weldability of molybdenum and W–Re–Mo alloys was temporarily concluded pending development of better methods of analyzing interstitial impurities. The study established that GE-NSP powder metallurgy molybdenum has less weld porosity and better bend ductility than a vacuum arc-cast molybdenum. Optimum electron beam welding conditions for 0.4- to 0.06-mm sheet were found to be 90 kilovolts and 4 milliamps using a double pass technique, with the beam defocused in second pass, and a post-weld stress relief treatment. A wrought structure or fine-grain material yielded better welds than large-grain material. Surface preparation did not appear critical at the purity level of GE–NSP materials, except that the surfaces had to be well mated. Oxygen seems to be the most critical impurity influencing weld porosity and ductility and the presence of carbon at concentrations up to about 250 ppM appears to be of minor importance. Strength tests were started on the first of several thermal mechanical treatments of the 19-9 DL alloy, tubes of this alloy of 6.35 mm dia by 0.38 mm wall thickness within acceptable dimensional tolerances were fabricated, and equipment for pressurized tube burst creep tests in argon neared completion. (J.C.W.)

24850 (GEMP–1008, pp 155-9) ADVANCED LONG-LIFE REACTOR FUEL CLADDING AND STRUCTURAL MATERIALS DEVELOPMENT. Robertshaw, F. C.; Bartos, J. L. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.).

Plans for a 135.6-kg vacuum induction melted heat of high-purity 316 SS are nearing completion. Additional thermal stability studies of warm-finished Cr-base alloys continue to indicate encouraging resistance to softening in long-term heating at 650 and 750°C. Tensile and creep-rupture data are reported for several high-strength Cr-base alloys. (J.C.W.)

24851 (GEMP–1008, pp 161-207) EVALUATIONS OF THE PLASTIC FATIGUE PROPERTIES OF HEAT-RESISTANT ALLOYS. Conway, J. B. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.).

Fatigue data were generated using axial strain control to evaluate the effects of various strain wave forms on the fatigue resistance of AISI 304 stainless steel at 650°C. Decreases in fatigue resistance were found to be controlled by the increase in plastic strain resulting from relaxation during hold periods. The fatigue results obtained with hold periods in tension only, however, showed a large decrease in fatigue resistance in these tests at the 2 percent strain range; a larger effect was noted in two tests at 0.5 percent strain range. True stress–strain data obtained in constant true strain rate tensile tests of AISI 304, 316, and 348 stainless steel at 430°, 650°, and 816°C in air are compared with cyclic stress–strain data generated at the same strain rate and temperatures. A metallographic investigation was made of the fractured surfaces and cross sections of specimens tested in fatigue with various strain wave forms and hold periods. (J.C.W.)

24852 (GEMP–1008, pp 229-51) PHYSICOCHEMICAL STUDIES OF CLAD UO_2 UNDER REACTOR ACCIDENT CONDITIONS. White, J. F. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.).

Dynamic testing in steam of internally pressurized tubes indicates that at internal pressures less than 0.05 kg/mm^2 tubes burst at all heating rates up to 300°C per second, and at pressures above approximately 0.08 kg/mm^2 the tubes expand to at least 34 percent when heating rates exceed a few tenths of a degree per second. Emittance determinations during isothermal oxidation tests indicate that the total hemispherical emittance for Zircaloy-4 cladding oxidizing under atmospheric conditions associated with a reactor loss of coolant accident lies in the range 0.7 to 0.8. Plastic flow in Zircaloy-4 is initiated prior to 0.2 percent strain. Maximum ductility in this material occurs near 1200°C. (J.C.W.)

24853 (GEMP–1008, pp 253-73) FAST BREEDER REACTOR THERMOCOUPLE DEVELOPMENT. Baxter, W. G.; Kuhlman, W. C. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.).

The design of ORTC-III in-pile test cartridge is complete and the fabrication of fuel pin assemblies was initiated. Efforts to fabricate small-diameter, thin-wall refractory metal thermocouple sheath tubing (15.24 cm long) of W–25 Re (at.%), W–25 Re–30 Mo (at.%), and rhenium produced small tubes by sinking, using a loose-fit piano wire for internal support. BeO insulators and HfO_2 insulators were tested and found stable in helium through 2400°C. High-purity thoria powder was obtained to fabricate insulators for similar testing. The metal-to-ceramic seal phase is a critical area. Flame-sprayed alumina on hypodermic needle stainless steel samples bonded to a stainless steel base body has not proved satisfactory. Porosity in the Al_2O_3 is a major problem area. Nickel plating of the tubing and stainless plug prior to flame spraying is the next phase to be studied. Type K duplex thermocouples will be tested in the circulating liquid metal loop to evaluate the influence of thermal cycles (650 to 300°C/hr) on the calibration of each. (J.C.W.)

24854 (GEMP–1008, pp 275-85) FAST BREEDER REACTOR CONTROL, SHIELD, AND REFLECTOR MATERIALS DEVELOPMENT. Van Houten, R.; Ober, R. F.; Kennedy, M. D.; Duderstadt, E. C. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.).

The development of suitable fabrication procedures for specimen preparation is continuing and numerous prototype test specimens were fabricated. Sound massive hydrided titanium and zirconium can be shipped freely as a result of recent Bureau of Explosives certification. (J.C.W.)

24855 (JAERI–1172) PROCEEDINGS OF THE 2nd SEMINAR ON PHYSICAL PROPERTIES OF FAST REACTOR FUELS [TOKYO, JAPAN, MARCH 29, 1968]. (Japan Atomic Energy Research Inst., Tokai. Tokai Research Establishment). Aug. 1968. 62p. (In Japanese and English). (CONF-680326). Dep. CFSTI.

Seven papers are included in which discussions of fuel effects on nuclear characteristics of fast reactors, swelling of carbide and oxide fuels, diffusion in nuclear fuels, phases of mixed PuO_2–UO_2, structure and vaporization of (Pu,U)C, and preparation of carbide fuel materials. (J.C.W.)

24856 (JEN–199-DMe/I-19) CONTRIBUTION TO THE METALLOGRAPHIC STUDY OF ZIRCONIUM HYDRIDES IN ZIRCALOY-2. Garcia Gonzalez, F. (Junta de Energia Nuclear, Madrid (Spain). Division de Metallurgia). 1968. 14p. (In Spanish). Dep.

Techniques for the identification of the zirconium hydrides in metallographic specimens have been developed. Microhardness, quantitative estimation, and relative orientation of the present hydrides as well as grain size determination of the different Zircaloy-2 tube specimens have also been made. The specimens used were corrosion-tested in water during various periods of time at 300°C, prior to the metallographic examination. Reference specimens, as received, and heavily hydrided specimens in a hydrogen atmosphere at 800°C, have been used in the previous stages of the work. (tr-auth)

24857 (NLCO–995) SUMMARY TECHNICAL REPORT [ON REACTOR MATERIALS] FOR THE PERIOD OCTOBER 1–DECEMBER 31, 1966. Burgett, R. (ed.) (National Lead Co. of Ohio, Cincinnati). Jan. 1967. Contract AT(30-1)-1156. 32p. Dep. CFSTI.

A Pressurized Low Temperature reduction facility was designed and built for studying the reduction of green salt by magnesium under 75 psig of argon at temperatures of 2250 to 2400°F. The process, equipment design, and operating procedures are reported. A beryllia-lined graphite valve was designed and fabricated to control the flow of molten U. Seam depths in rolled uranium rods were measured accurately using an eddy current. Binary uranium alloys containing as much as 1000 ppM of C, Fe, Si, and Al were hardness-tested at 885 to 1200°F. Thorium nitrate crystals approaching the stoichiometry of the pentahydrate have been prepared by cooling concentrated solutions of thorium nitrate on an experimental water-cooled belt conveyor. (J.C.W.)

24858 (NP–17821) UNIDIRECTIONALLY SOLIDIFIED COBALT-BASED ALLOYS FOR ELEVATED TEMPERATURE MAGNETIC APPLICATION. Scientific Paper 69-1J7-CERAM-P1. Kossowsky, R.; Colling, D. A. (Westinghouse Research Labs., Pittsburgh, Pa.). Jan. 14, 1969. 29p. CFSTI.

Mechanical properties and magnetic performance were investigated in a series of Co-Nb eutectic alloys. It was found that mechanical properties, such as short time compression and creep,

of the directionally solidified eutectic were quite sensitive to the perfection of the lamellar structure. The results indicate also that the basic structure of the eutectic can be preserved and controlled despite the addition of iron. The addition of iron improved magnetic performance but lowered the Curie temperature. (auth)

24859 (NRL-6873) CHARACTERIZATION OF FRACTURE TOUGHNESS OF 5Ni-Cr-Mo-V STEEL BY CHARPY V-NOTCH AND DYNAMIC TEAR TESTS. Judy, R. W. Jr.; Puzak, P. P.; Lange, E. A. (Naval Research Lab., Washington, D. C.). Dec. 13, 1968. 14p. CFSTI.

Samples of 5Ni-Cr-Mo-V steel in plate and weld metal were investigated with respect to fracture toughness characterization features provided by the Dynamic Tear (DT) and Charpy V-notch (C_V) tests. The intrinsic fracture propagation features were defined by the energy-temperature relations obtained with the DT test. The fracture modes of both base metal and weld metal as defined by the DT test demonstrated sharp transitions in fracture toughness with temperature. In contrast, the fracture modes of the C_V test remained essentially unchanged and the energy curves had shallow, indefinite slopes. A very high degree of scatter for the C_V energy values was observed for weld metal. The scatter was attributed to the inherent metallurgical differences found in multipass weldments and the small sampling size in the C_V test. The DT test method provides for a choice of specification criteria for assessing the fracture toughness of these materials based on a DT energy value at a single or at several temperatures. The choice of specific criteria depends on the reference aims as relating to properties involving the transition region or the shelf level. Procedures for establishing significant C_V test criteria are described. In general, the use of the C_V test is complicated by difficulties of interpretation of energy values relating to the transition region and the shelf. (auth)

24860 (ORNL-4377, pp 13-54) INVESTIGATION OF UNIRRADIATED MATERIALS. (Oak Ridge National Lab., Tenn.).

Results obtained in programs devoted to unirradiated specimens in the areas of inspection, characterization, variability testing, transition temperature testing, fracture mechanics testing, and fatigue-crack propagation are summarized. (F.S.)

24861 (ORNL-4377, pp 97-109) PRESSURE VESSEL INVESTIGATIONS. (Oak Ridge National Lab., Tenn.).

Activities devoted to complex-stress-state investigations, periodic proof testing, and warm prestressing of simulated pressure vessel materials are reported. Information is included on fabrication of molded epoxy models, and on evaluation of periodic proof testing and warm prestressing methods used to establish assurance against pressure vessel failure. (F.S.)

24862 (ORNL-4390, pp 72-81) ZIRCONIUM METALLURGY. Weir, J. R. Jr.; Rittenhouse, P. L. (Oak Ridge National Lab., Tenn.).

Twelve experimental fabrications of Zircaloy tubing were completed. Tubing was reduced to final size by tube reducing, cold drawing, swaging, and planetary swaging. Heavy sinking by swaging was unsuccessful, but sinking by drawing was completed without difficulty. Comparison of deformation and annealing textures of Zircaloy tubing showed that annealing can produce greater texture changes than previously observed. After annealing, shift was found in the preferred position of the basal poles and decreases in texture intensity. The commonly reported exchange of prism pole positions has been found. These differences in behavior seem to be related to the nature of the deformation before the anneal. Work on texture development, gradients, and variations is continuing with special attention to the materials produced in the experimental fabrication. Six commercial fuel cladding tubes for circumferential texture variations were examined. The variation in basal pole intensity was >30% in five tubes and was >80% in one tube. There were cyclic variations in four tubes. Experimentation showed the influence of texture on the biaxial mechanical behavior of Zircaloy tubing. Depending on the texture present, the stress required to produce plastic yielding can vary by 50% or more for materials tested in the same stress state. (auth)

24863 (ORNL-4390, pp 159-76) TUNGSTEN METALLURGY. Patriarca, P. (Oak Ridge National Lab., Tenn.).

Duplex extrusion of four powder-metallurgy tungsten tube shells at extrusion temperatures of 1250, 1450, 1650, and 1750°C was completed. Specimens were cut from the extrusions to determine the effect of extrusion temperature on microstructure and working properties. In chemical vapor deposition (CVD) studies, a series of experiments was conducted to systematically determine the effect of various deposition variables on the uniformity of the thickness of W-5% Re sheet deposits. The results indicate that optimizing the deposition pressure between 10 and 100 torr will produce uniformly thick deposits. Experiments with the W-25% Re deposition system showed that the content of Re in the deposit was equal to that in the gas phase for deposition temperatures between 700 and 1200°C. Studies to determine the effect of HF on the surface morphology of tungsten deposits showed two unexpected results. The addition of HF to the inlet gas produced deposits that had a smoother surface, and the metal recovery was greater. In another CVD study, vanadium metal was deposited by the reaction of entrained VCl_3 and H_2 on an induction-heated graphite substrate at 1200 and 1300°C. Preliminary bend tests of CVD W-5% Re showed that the material was very brittle as deposited because of grown-in porosity or inhomogeneous alloying. However, after a 1-hr anneal at 2200°C, a ductile-brittle transition temperature of 125°C was found, which is lower than any other reported value for unworked W-Re alloys. An electron microscope fractographic study of fusion welds in powder-metallurgy, arc-cast, and chemically vapor-deposited W revealed that hot cracking in these materials is a result of stress-induced growth and a merging of very small gas bubbles at the grain boundaries at the high temperatures and stresses imposed during welding. Additional long-time creep-rupture data for unalloyed W was obtained at 1400, 1650, and 2200°C. The Larson-Miller constant calculated from these results was used to obtain an estimation of the creep-rupture curves at 1800 and 2000°C. (auth)

24864 (ORNL-4390, pp 189-203) JOINING RESEARCH ON NUCLEAR MATERIALS. Adamson, G. M. Jr.; Slaughter, G. M. (Oak Ridge National Lab., Tenn.).

Sulfur has a much more deleterious effect on the hot ductility of Inconel 600 heat-affected zones than does P. Furthermore, small additions of Mn do not improve the properties of compositions containing S. Studies on alloys of the Incoloy 800 type show that some exhibit a ductility minimum at intermediate temperatures and then recover at elevated temperatures; other compositions exhibit a continuous decrease in ductility with increasing test temperature. All of the alloys that recovered ductility contained 0.40 wt % Ti. In support of the Fast Flux Test Facility (FFTF) primary vessel program, stainless steel weldments for irradiation are being produced. The 130 specimens machined from submerged-arc welds have been delivered, and the preparation of gas metal-arc and shielded metal-arc welds is under way. The effects of welding conditions on the occurrence of discontinuities are being determined. (auth)

24865 (ORNL-4390, pp 204-22) DEVELOPMENT OF LMFBR TUBING FABRICATION. Adamson, G. M. Jr. (Oak Ridge National Lab., Tenn.).

Tubes of titanium-modified type 304 stainless steel have been fabricated; the resulting microstructure was affected by the processing variables. Pole figures were determined for the titanium-modified type 304L stainless steel after processing by several different schedules. The preferred orientation consisted of two components analogous to the (011)[$\bar{1}$00] and (322)[$\bar{4}$33] rolling textures. Transmission electron microscopy showed the presence of carbides and martensite in the cold-worked tubing. Tube burst tests have been run on tubes of titanium-modified type 304L stainless steel at 600 and 700°C. The results indicated generally that the rupture life was increased and the fracture strain decreased by cold working. Annealed tubing failed at low strains when flaws were observed, and cold-worked tubing failed at flaws that were too small to be detected by conventional techniques. (auth)

24866 (ORNL-4390, pp 294-8) CLADDING MATERIALS FOR SPACE ISOTOPIC HEAT SOURCES. Patriarca, P.; Donnelly, R. G. (Oak Ridge National Lab., Tenn.).

Creep tests are being conducted to determine the minimum thickness of Haynes alloy No. 25 that will not be adversely affected by evaporation in vacuum to 800°C. It has been found that increased surface area is responsible for enhanced evaporation of a specimen undergoing creep. Ordered alloys with low vapor pressures, under study as improved cladding materials, have been fabricated into test specimens. Hardness tests at room temperature and elevated temperatures indicate superior strength in alloys exhibiting long-range order. (auth)

24867 (ORNL-TM-2307) DESORPTION OF CARBON MONOXIDE FROM TUNGSTEN BY BOMBARDMENT WITH ELECTRONS. Clausing, Robert Eugene (Oak Ridge National Lab., Tenn.). Apr. 1969. Contract W-7405-eng-26. 139p. Dep. CFSTI.

Thesis. Submitted to Univ. of Virginia, School of Engineering and Applied Science, Charlottesville.

A mass spectrometric technique to measure the quantity of neutral molecules released by electron impact from metallic surfaces covered with adsorbed gases was used to investigate the electron bombardment induced desorption of CO from W.

It was possible to separate the effects of thermal desorption due to the very small amount of target heating that accompanied the electron bombardment from the effects of electron impact per se. The thermal effects were shown to be negligible for the conditions of this study. The desorption of neutral CO molecules from a W ribbon with predominantly [100] poles normal to the surface was measured for electron energies in the range from 30 to 8,000 electron volts. Between 3×10^{-6} and 6×10^{-5} molecules were desorbed per incident electron, depending upon the electron energy. The desorption appears to be from the alpha form of chemisorbed CO, whose measured population was about 10^{13} molecules cm^2. The desorption cross section for neutral CO from this alpha state is then calculated to be about 4×10^{-18} cm^2 for electrons having energies of 100 eV. The threshold of electron energy necessary to cause desorption is approximately 20 V. (auth)

24868 (ORNL-tr-2039) HIGH VACUUM PURIFICATION OF NIOBIUM AND TANTALUM AND ITS EFFECT ON THE ELECTRICAL RESISTANCE. Dinter, Reiner-Joachim. Translated by R. P. Tucker and R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Z. Metallk., 58: 70-5(1967). 19p. Dep. CFSTI.

Experiments are described for freeing niobium and tantalum from interstitial impurities. By annealing in high vacuum, the content of interstitially dissolved foreign atoms was reduced to about 10 at.-ppM from an initial value of 3800 or 300 at.-ppM. Niobium specimens pretreated in this way did not show an electric conductivity recovery stage after plastic deformation and subsequent tempering at room temperature to 360°C, but instead a small continuous decrease in resistance was observed. The recovery of resistance of a purified specimen which has not been charged with gas is greater than the additional resistance caused by residual impurities, the latter resistance anneals out. The observed recovery may be due to annealing of structural point defects which have been produced during deformation. (auth)

24869 (ORNL-tr-2101) APPLICATION OF THERMODYNAMICS TO THE DEVELOPMENT OF INDUSTRIAL PURIFICATION METHODS OF REFRACTORY METALS AND SEMI-METALS. Accary, Andre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Translation of report CEA-R-3390. 20p. Dep. CFSTI.

Application of electron beam melting for purification of metals is examined. Examples of purification thermodynamics are given using the cases of V and UC. (J.R.D.)

24870 (WARD-3791-29) STAINLESS STEEL CLADDING DEVELOPMENT. Quarterly Progress Report for the Period Ending December 31, 1968. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Feb. 1969. Contract AT(30-1)-3791. 29p. Dep. CFSTI.

Tensile test and biaxial stress rupture tests were conducted on Type 316 stainless steel tubing at 850, 1000, and 1200°F. The biaxial stress rupture data were compared with other available data. Data obtained on micro-peened tubing revealed improvements in short-time mechanical properties. A program involving the characterization of tubing processed by planetary swaging was planned. Under Task SSAA-310, preliminary examination of a stress-rupture specimen revealed intergranular as well as secondary transgranular cracks. Sensitization studies were initiated using the temperature range 750 to 1650°F for times up to 5000 hours. (auth)

24871 (WARD-3791-31) URANIUM-PLUTONIUM CARBIDE DEVELOPMENT. Quarterly Progress Report for the Period Ending December 31, 1968. Biancheria, A.; Jacoby, W. R. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Oct. 1968. Contract AT(30-1)-3791. 69p. Dep. CFSTI.

A statistically designed experimental program was run to determine the major effects of process variables on stoichiometric and hyperstoichiometric fuel. The effects of varying binders, milling time, sieve size, purge gas flow rate, and sintering temperature use rate were studied. Carbon contents of 4.45 and 4.75 wt % were used for the stoichiometric and hyperstoichiometric compositions, respectively. Fabrication of EBR-II Phase I fuel pellets continued. As high tungsten values were noted in batches of pellets fabricated previously, steps were initiated, to identify the contamination sources and to minimize the problem. A physical inventory of the characterization line and vault was conducted. In addition, many scrap batches were oxidized, combined whenever possible into larger batches, and then sampled for Pu and U contents. Routine analytical chemistry and metallographic analyses of potential EBR-II Phase I fuel continued. A series of samples were sent to LASL for electron microprobe, DTA, and x-ray diffraction examinations. Two irradiation test pins (W1E and W2E) were successfully fabricated. Difficulty was experienced in the sodium bonding of pin W2E, which had only a four-mil radial gap between the pellets and tubing ID. The thermal irradiation capsules were discharged from GETR. Capsules W1G and W2G were discharged after 6½ cycles exposure, and W3G was discharged after seven cycles exposure. Subsequent to discharge of the fuel pins from GETR, post-irradiation neutron radiographs were made. The radiographs indicated extensive cracking in pellets in the M pins but no cracks in the low-power pins. The three capsules are presently stored in the GETR canal awaiting postirradiation examination. The first two irradiation fuel pins, containing Cr-modified fuel, were accepted and allocated to subassembly X050. Work continued on the design study of the 12-capsule subassembly. (auth)

24872 (WARD-3791-32) OXIDE FUEL ELEMENT DEVELOPMENT. Quarterly Progress Report for the Period Ending December 31, 1968. Biancheria, A.; Bishop, A. A.; Boltax, A.; Ray, W. E.; Riley, B. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Feb. 1969. Contract AT(30-1)-3791. 55p. Dep. CFSTI.

Analysis of stainless steel cladding swelling data was continued and the effects of cladding failure on fuel behavior were examined. Discrepancies in data on the creep strength of 316 stainless steel were investigated and minor variation in composition or mechanical or thermal treatment were found to cause significant variations in mechanical properties and microstructure. Preliminary design studies were conducted on the conceptual design of a fuel pin with fixed spacers compartmenting the fuel column, the spacers are used to provide more reproducible fuel expansion. Type 316 stainless steel dimpled grids were used in a 37-pin assembly. (F.S.)

24873 ELECTROMIGRATION AND DIFFUSION OF CADMIUM AND INDIUM IN LIQUID SODIUM. Epstein, Seymour G. (Brookhaven National Lab., Upton, N. Y.). Phys. Chem. Liquids, 1: 109-19(Dec. 1968).

Mass transport induced by an electric current (electromigration) and by a concentration gradient (diffusion) was measured as a function of temperature in liquid sodium containing small amounts of cadmium or indium. While the calculated diffusion coefficients fall within values normally found for diffusion in liquid alloys, the electromigration behavior was strikingly different from observations in liquid mercury and bismuth alloys. In sodium, cadmium and indium migrate to the anode (in mercury and bismuth, they migrate to the cathode) with mobilities 25 to 50 times larger than in mercury or bismuth. These findings are explained, at least qualitatively, by a recently proposed model which describes electromigration in terms of an electron drag. The data are in better agreement when expressed as a "coefficient of electron drag," which is dependent on the current density, than as a mobility, which is a velocity per unit field. (BBB)

24874 MORPHOLOGICAL CHANGE OF A TUNGSTEN POINT BY SURFACE DIFFUSION: FORMATION OF SOLID DROPS. Drechsler, M. (Univ. d'Aix-Marseille); Piquet, A.; Uzan, R.; Vu Thien Binh. Surface Sci., 14: 457-60(Apr. 1969). (In French).

The reshaping of tungsten tips by surface diffusion at 2500°K is studied with a scanning electron microscope. The formation of constrictions and solid drops predicted by Nichols and Mullins is confirmed except the drop detachment. Beyond that, the formation of other types of shape is found, e.g., thin filiform necks and angular constrictions at grain boundaries. (auth)

24875 CHANGES IN THE RESISTANCE OF MOLYBDENUM FILMS DUE TO THE ADSORPTION OF CARBON MONOXIDE. Ansbacher, T. H. (Univ. of Vermont, Burlington). Surface Sci., 14: 461-4(Apr. 1969).

Measurements were carried out on 200 Å-thick Mo films deposited under conditions leading to low porosity. The resulting plot of percent change in resistance as a function of CO coverage is used to calculate the ratio of fractional change in resistance to number of adsorbed molecules per metal atom ($\alpha = 4$). This can be interpreted on the basis of adsorption altering the number of charge carriers; from the equation $\alpha = \frac{2}{3}\chi/\gamma$, γ (the number of conduction electrons from each metal atom) is found to be 0.3, low but of the correct order of magnitude. (D.L.C.)

24876 CESIUM PLASMA SPECTRA IN THE SYSTEM W(100)–Cs. Lander, J. J.; Morrison, J. (Bell Telephone Labs., Murray Hill, N. J.). Surface Sci., 14: 465-72(Apr. 1969).

A very strong 1.5-eV loss peak has been observed in the backscattered inelastic electron LEED spectra near the saturated "duolayer" cesium coverage in the W(100)–Cs system. This is interpreted as a two-dimensional Cs plasma excitation. With multilayer cesium coverage it is observed to shift gradually to

2.4 eV. Correlation of this with diffraction patterns, change in work function, and cesium Auger spectra supports the "duolayer" interpretation proposed by MacRae, Müller, Lander and Morrison. The very large cross section suggests that it is probably an important factor in other surface phenomena, e.g., photoemission. Such spectra provide important parameters for the characterization of monolayer and thin film phenomena. (auth)

24877 FEATURES OF THE TECHNOLOGY OF MELTING IN THE VACUUM ARC FURNACE. Eminger, Zdenek; Kletecka, Zdenek. Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove, 13: 65-84(1967). (In Czech).

The history and the potential of vacuum arc technology were discussed. The influence of the state of the initial consumable electrode on the final quality of the remelted ingot was investigated. The loss of Mn, Al, Cr, and Cu elements below and Ti, Mo, W, and V above the evaporation point of Fe during vacuum arc remelting was studied. The loss of several elements was affected by the composition of the remelted material. During the melting process, the C, Si, P, S, Cr, Al, Mo, and V content remained constant. During rapid vacuum melting Mn evaporated and complicated the melting process. Steels containing Mn > 4% are not recommended for remelting in vacuum arc. The effect of bath depth on the mode in which the remelting metal solidifies was studied in laboratory and industrial size moulds. (Metals Abstr.)

24878 ON THE STATE OF OXYGEN ADSORBED ON THE SURFACE OF TUNGSTEN AND MOLYBDENUM SINGLE CRYSTALS. Vas'ko, N. P.; Ptushinskii, Yu. G.; Chuikov, B. A. (Inst. of Physics, Kiev). Surface Sci., 14: 448-56(Apr. 1969).

The desorption kinetics of the atomic and oxide phases have been studied to determine the composition of the surface film formed upon interaction of oxygen at low pressure with the surface of W and Mo single crystals. The results support the following ideas on the composition of an adsorbed film. Oxygen in the atomic state is present on the surface of all the substrates investigated irrespectively of their temperature during adsorption. Oxides are formed on the (100) planes of W and Mo during adsorption if the substrate temperature is high enough (~1000°K). If adsorption proceeds with the substrate at room temperature, the oxides in the desorption products are most likely due to the temperature rise during flashing, and the state on the substrate surface of the oxygen desorbed as oxides is unknown. On the (110) plane of W, oxides are formed also at room temperature. (auth)

24879 THE EFFECT OF DEFORMATION ON THE NATURE OF TRANSFORMATIONS DURING THE SUBSEQUENT ANNEALING OF NICKEL–MOLYBDENUM ALLOYS. Dubrovina, A. N.; Umansky, Ya. S. pp 105-9 of Diffuzionnye Protsessy v Metallakh. Kiev, Nauk Dumka, 1968. (In Russian).

X-ray analyses, electrical resistance, and hardness measurements were used to study the transformations in (i) Ni–20.8% Mo and (ii) Ni–16.7% Mo alloys deformed ~40% by drawing, after quenching and isothermal annealing at 500 to 800°C. On annealing alloy (i) there was primarily a precipitation of the Ni_3Mo phase with a somewhat distorted hexagonal lattice. In alloy (ii) no stacking defects were found after deformation and the Ni_3 Mo phase was not detected after annealing. After prolonged annealing of (i) ordering of the Ni_4Mo type occurred, this phase occurring as a precipitate. Annealing at 800°C led to a coarsening of the structure and recrystallization of the solid solution. With (ii) recrystallization began even after 10 min annealing at 800°C and the excess phase, Ni_4Mo, was precipitated at the end of the recrystallization. The nature of the dependence between the degree of tetragonality and the volume of the elementary cell of the Ni_4Mo phase was the same for Ni_4Mo precipitated during annealing in the deformed and undeformed alloys. In the deformed alloy (ii) the ordering began with lower concentrations of Mo in the nuclei than in the quenched alloy, the rate of enrichment of the nuclei by Mo being correspondingly greater. (Referativyni Zh.)

24880 THE EFFECT OF COATING THICKNESS AND METALLIC ADDITIONS TO THE COATING ON THE RATE OF FUSION OF WELDING ELECTRODES. Kotov, G. N.; Erokhin, A. A. Avtomat. Svarka, No. 8, 16-17(1968). (In Russian).

A study was made of the effect of coating thickness and the presence of additional metallic elements in the coating, on the rate of fusion of welding electrodes. The electrodes studied were coated rods, 5 mm dia, of Kh20N80T alloy, i.e., 80:20 Ni–Cr alloy containing Ti, with additions of W, Mo, and Mn (as 20 to 65% of the weight of the mixture) to a coating consisting of marble and fluorspar loaded with water glass. An equation was derived from the experimental results describing the relative reduction in the linear rate of electrode fusion with increase in the content of metallic additions, or with increase in thickness, of the electrode coating. The equation takes account of the ratio of the coating thickness to electrode thickness, the coating density and the heat consumed during its fusion. (Metals Abstr.)

24881 ALUMINUM AND MAGNESIUM. Hallowell, J. B. DMIC Rev., 4p.(Nov. 13, 1968).

Research from 1960 to 1967 on the effect of rapid solidification rates on dendrite arm spacing and tensile properties of Al–Zn–Mg alloys was reviewed. Significant improvements in the strength of wrought alloys could be realized if very small dendrite-arm spacing and complete solutionizing conditions were achieved as was done in laboratory samples. A study on the strengthening of Al–Zn alloys (30 to 60 wt % Zn) by the effect of spinoidal decomposition was described. Structure, aging kinetics and mechanical properties of binary Al–Zn alloys and hybrid alloys were studied. Experimental results were cited for Al–38 Zn and Al–38 Zn–2 Cu alloys. The use of high-purity Al as an alternative material for the coil of a very high field strength magnet (50 kG) and development and evaluation of alloys of Mg–Y and Mg–Y–Zn–Zr, Mg–Sc and high-strength alloys of Mg–Zn–Mn were discussed. Data are included on mechanical properties, treatment and composition. (Metals Abstr.)

24882 BERYLLIUM. Zurey, F. T.; Hanes, H. D. DMIC Rev., 4p.(Oct. 23, 1968).

The ductile-brittle behavior of Be and the development of techniques which make use of a divergent x-ray beam, the flow and fracture characteristics of zone-purified Be and Be-rich alloys and the influence of loading rate and testing temperature on the fracture toughness of 7902 Be hot rolled sheet were discussed. The brittleness of Be was studied in three relatively distinct approaches: bicrystals and their behavior; prestraining effects; and theoretical analysis of mechanical behavior. A test for Be tubing expansion which is used for nuclear reactor fuel cladding, was devised. The recovery and recrystallization of Be alloy sheet with additions of 3.3% Cu or 4.2% Ni were studied. In the field of powder metallurgy, the effects of powder-particle size on the physical behavior of press-forged Be and the development of ultrafine Be powder by the amalgam process are of current interest. (Metals Abstr.)

24883 MULTIPHASE: UNIQUE ALLOY SYSTEM FOR HIGH STRENGTH AND CORROSION RESISTANCE . Fletcher, S. G.; Yates, D. H. Technical Report No. D8-7,1. Metals Park, Ohio, American Society for Metals, 1968. 18p.

The metallurgy and properties of a newly-developed alloy system of Co–Ni–Cr–Mo, called MULTIPHASE were described. Most of the data were based on one alloy in the system, MP35N, which contained 35% Co, 35% Ni, 20% Cr, 10% Mo and which showed extremely high strength and ductility, combined with outstanding resistance to marine corrosion. The MULTIPHASE alloys were strengthened by a phase transformation that must be induced by deformation; even higher strength levels resulted from subsequent aging. The alloys appeared to have ideal properties for applications such as high-strength fasteners, marine cable and hardware, surgical implants, pressure tubing and others requiring resistance to corrosion along with high strength and toughness. (Metals Abstr.)

24884 FERROMAGNETIC PROPERTIES FOR ANALYTICAL PURPOSES. Tomik, Bohuslav; Tyl, Jiri. Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove, 14: No. 1, 75-88(1968). (In Czech).

The method and the equipment for analysis of powder materials (Fe–Cr, Fe–Ti, and Fe–W) on the basis of their ferromagnetic properties was described. The method was applicable to the determination of Cr in low-C Fe–Cr and of Ti in Fe–Ti. The frequencies of two oscillators were compared after inserting the sample into a coil of the measuring circuit. Of the double ferro alloys, the following possessed ferromagnetic properties: Fe–Si up to 33% Si, Fe–Cr up to 70% Cr, Fe–B up to 15% B, Fe–Ce up to 100% Ce, Fe–Mn up to 16% Mn, Fe–Mo up to 53% Mo, Fe–P up to 21.7% P, Fe–Ti up to 30% Ti, Fe–W 60 to 70% W, and Fe–V up to 67% V. The best result was achieved in low-C Fe–Cr alloy of grain size <0.2 mm; the deviation was ±0.34% of Cr. In Fe–Ti alloy, grain size <0.06 mm, the deviation was ±0.36% of Ti. (Metals Abstr.)

24885 TOOL MATERIAL SELECTION AND APPLICATION. Galimberti, James M. Technical Paper No. MR68-618. Dearborn Mich., American Society of Tool and Manufacturing Engineers, 1968. 11p.

The characteristics of materials available to the metal cutting industry for edge cutting tools were given, including carbon and high speed steels, cast Co-base alloys, tungsten carbides, titanium carbides, ceramics and diamond. In general, selection of a particular tool was based primarily on toughness and hot hardness, the initial cost of the tool material and the work material and machining conditions. These led to secondary considerations of

the max. production rate attainable and min. tool cost. Graphs showed the three mutually perpendicular cutting force components acting on a cutting edge, the magnitude of these components under typical machining conditions, the main sources of heat during machining and the temperature as a function of feed and speed. Built-up edges due to adhesion, crater wear due to diffusion and thermal cracks due to severe temperature gradients were also shown. (Metals Abstr.).

24886 THE NATURE OF ABRASIVE-PROCESSED SURFACES. Tarasov, L. P.; Littmann, W. E. Technical Paper No. MR68-517. Dearborn, Mich., American Society of Tool and Manufacturing Engineers, 1968.

Grinding and other types of abrasive processing may produce cracks and burns that lead to failure by fracture and changes in residual stress of the surface layer. Heat and plastic deformation from the abrasive action also can affect microstructure and this in turn modifies the residual stresses and fatigue strength. The ability of the surface to withstand stress-corrosion or corrosion-fatigue may also be reduced. The nature of these effects was considered for 4340 steel, 4620 steel, 1018 steel, Ti–6Al–4V alloy, 52100 steel, D6AC steel, W, Rene 41 and TZM Mo alloy. (Metals Abstr.)

24887 STATUS OF PIPE-RUPTURE STUDY AT GENERAL ELECTRIC. PART II. Vandenberg, S. R. (General Electric Corp., Pleasanton, Calif.). Nucl. Safety, 10: 217-27(May-June 1969).

The pipe-rupture study is concerned with extending current understanding of failure-causing mechanisms and providing improved capability for evaluating reactor piping systems to minimize the probability of failures. Following a detailed review to determine the work most needed to improve nuclear system piping, analytical and experimental efforts were started in April 1965. The accomplishments during the initial 3 years of a broad program in reliability engineering of actual reactor piping systems; solution of heretofore intractable problems in stress analysis; fracture mechanics; fatigue studies through both bench-scale and large-component tests; and at-reactor tests of the effect of primary coolant environment on the fatigue life of primary piping steels are summarized. (auth)

24888 TRACKING THE EARLY STAGES OF PLASTIC DEFORMATION OF MOLYBDENUM BY ULTRASONIC DAMPING MEASUREMENTS DURING TENSION TESTS. Zingsheim, H. P. (Metallwerk Plansee AG, Reutte/Tirol, Austria). Planseeber. Pulvermet., 16: 283-92(Dec. 1968). (In German).

Ultrasonic damping experiments were carried through on cylindrical molybdenum specimens while they were deformed in tension. The results are similar to previous findings. (tr-auth)

24889 PALLADIUM ALLOYS. Savitskii, E. M.; Polyakova, V. P.; Tylkina, M. A. New York, Primary Sources/Publishers, 1969. 219p. $24.50.

Translated by R. E. Hammond from Splavy Palladiya.

Experimental findings and industrial applications are incorporated to correlate wider uses for palladium. Chemical, mechanical, and physical properties of palladium and its alloys are studied. Phase diagrams and the reactions of palladium with other elements are presented. Production and heat treatment methods are described. Chemical, electrical, and radio engineering industries are included in the applicable industries for the metal. Citations are included from Russian and Western sources. (J.C.W.)

24890 MODERN MATERIALS. ADVANCES IN DEVELOPMENT AND APPLICATIONS. VOLUME 5. Gonser, Bruce W. (ed.). New York, Academic Press Inc., 1965. 387p. $15.00.

Information in the volume is presented in four sections. A separate abstract was prepared for one section. Sections for which no abstracts were prepared are concerned with precipitated metal powders and rolling, luminescence and phosphors, and concrete. (J.R.D.)

For an abstract of the individual section see: 24891.

24891 COATED REFRACTORY METALS. Krier, C. A.; Baginski, W. A. (Boeing Co., Seattle). Mod. Mater., Advan. Develop. Appl., 5: 1-103(1965).

Materials that have sufficient ductility as well as strength to be used for structural applications involving operating temperatures to 4500°F are discussed. Interactions between coating materials and refractory alloys involve chemical and structural compatibility. Processes for coating refractory alloys are summarized. An evaluation of coated refractory alloys is made. Properties of coated refractory alloys and metals and specifically of Mo, Nb, Ta, V, and W are given. (J.C.W.)

24892 DEFORMATION OF BERYLLIUM SINGLE CRYSTALS UNDER HIGH PRESSURE. Damiano, V. V.; Hanafee, J. E.; London, G. J.; Inoue, N. (Franklin Inst. Research Labs., Philadelphia). Trans. Met. Soc. AIME, 245: 637-49(Apr. 1969).

The c axis compression behavior of beryllium single crystals at three purity levels under hydrostatic pressures up to 27 kbars were determined. Extensive nonbasal slip, observed by two-surface trace analysis and transmission electron microscopy, occurred under a hydrostatic pressure of about 12 kbars for the twelve-zone pass material and at about 19 kbar for the zone-leveled material. Prismatic loops with a (c + a) Burgers vector were observed in association with second-phase particles in the lower-purity materials tested. The loops were related to surface extrusions observed on many of these same specimens. Nonbasal dislocations operating on $\{11\bar{2}2\}$ planes with a (c + a) Burgers vector were observed. The presence of c and a dislocations together with (c + a) dislocations suggests that the (c + a) dislocations dissociate presumably on unloading or after failure of the test crystals to c and a dislocations. (auth)

24893 HIGH-TEMPERATURE PLASTIC DEFORMATION OF POLYCRYSTALLINE RHENIUM. Vandervoort, R. R.; Barmore, W. L. (Univ. of California, Livermore). Trans. Met. Soc. AIME, 245: 825-9(Apr. 1969).

Tensile creep experiments were conducted on high-purity, polycrystalline rhenium from 1500 to 2300°C at stresses from 1500 to 10,000 psi in a vacuum of 10^{-8} torr. The apparent activation energy for creep was 60 kcal per mole, and the steady-state creep rate varied directly with stress to the 3.4 power. Dislocation substructure that developed during creep was studied by transmission electron microscopy. Possible rate-controlling deformation mechanisms are discussed. (auth)

24894 CREEP OF POWDER METALLURGY RHENIUM AT 0.43 TO 0.72 T_m. Raffo, Peter L.; Witzke, Walter R. (Lewis Research Center, Cleveland). Trans. Met. Soc. AIME, 245: 889-90(Apr. 1969).

The creep rate-stress-temperature relation of creep of powder metallurgy rhenium was studied at $<10^{-5}$ torr at 2200 to 4000°F at stresses ranging from 4 to 20 kip/in^2. Activation energy was found to be 64.4 kcal per g-mole, independent of stress. An activation energy of 62.7 kcal per g-mole was determined from the temperature variation of the rupture life. The high-temperature creep appears to be anomalous in both its low activation energy and stress dependence. (F.S.)

24895 NONHOMOGENEOUS DEFORMATION IN ZIRCALOY TUBING. Hobson, D. O.; Rittenhouse, P. L. (Oak Ridge National Lab., Tenn.). Trans. Met. Soc. AIME, 245: 797-800 (Apr. 1969).

It was recently found that many lots of Zircaloy-2 and -4 tubing tested in tension deform to cross section shapes that are polyhedral rather than circular. The noncircular cross sections seem to result from a circumferential variation in plastic properties and, therefore, in texture. The diffracted x-ray intensity from (0001), $\{10\bar{1}0\}$, $\{11\bar{2}0\}$, and $\{10\bar{1}1\}$ planes parallel to the tubing surface around the entire circumference was examined. Tubing that deformed to a circular cross section showed <5% variation in diffraction intensity around the circumference from any of these planes. Greater intensity variations were found for all the tubing materials that developed noncircular cross sections during deformation. In each instance the number of intensity maximums and minima was consistent with the number of sides of the polyhedral cross section. (auth)

24896 FLUXOID PINNING BY SECOND PHASES IN A SUPERCONDUCTING NIOBIUM–ZIRCONIUM ALLOY. Waldron, G. W. J. (General Electric Co. Ltd., Wembley, Eng.). J. Mater. Sci., 4: 290-301(Apr. 1969).

The effects of second phases on the critical currents of superconducting niobium-zirconium alloys containing a nominal 25 wt % zirconium were determined by superconducting magnetization experiments. Heat treatment of annealed and extruded materials in the temperature range 600 to 900°C led to a cellular decomposition of the high temperature β structure into two isostructural phases, one niobium-rich (β_{Nb}) and the other zirconium rich (β_{Zr}), with an accompanying increase in critical current (at an average field of 20 kOe) up to twelve times the original value. Heat treatment of quenched tubes at 800 or 900°C produced precipitation on sub-boundaries prior to the cellular reaction, this being accompanied by an increase in critical current to at least thirteen times the original value. In this case, however, prolonged heating led to a fall in critical current, which it is suggested is an "overageing" effect. (auth) (UK)

24897 PLASTIC DEFORMATION AND MAGNETIC PROPERTIES OF TUNGSTEN CARBIDE SOLID SOLUTIONS IN

COBALT. Tumanov, V. I.; Shchetilina, E. A.; Elmanova, S. M.; Cheredinov, A. A. (All-Union Scientific Research Inst. of Hard Alloys, Moscow). Porosh. Met., Akad. Ukr. SSR, No. 2, 77-81 (Feb. 1969). (In Russian).

The magnetic permeability of solid solutions of Co–WC with varying tungsten carbide content was investigated. Applicability of the given characteristic is shown for estimating the internal stresses at plastic deformation of the samples and for investigating a deformation mechanism. Data on the dependence of the Curie temperature on tungsten carbide content in Co–WC alloys indicate that it may be possible to determine by θ value the chemical composition of the binding phase of tungsten–cobalt hard alloys having a known amount of cobalt. (auth)

24898 PRECIPITATION IN BERYLLIUM–IRON ALLOYS. Morozumi, Shotaro; Tsuno, Nobuo; Koda, Shigeyasu (Tohoku Univ., Sendai). Trans. Jap. Inst. Metals, 10: 64-9(Jan. 1969).

Hardness measurements and microscopic observations by both optical and transmission electron microscopy were carried out mainly on a beryllium–3 wt % iron alloy. The alloy was solution-treated at 1150°C, followed by oil-quenching, and aging at 400 to 700°C for various times. In the quenched specimens, helices and loops of dislocations were observed. The aging treatment resulted in climbing of the dislocations and also preferential precipitation on dislocations as well as at grain-, twin-, and sub-boundaries. Although the change in hardness due to aging was not so large, two different stages were found in the aging process, and it was considered that the first stage was associated with the climbing of dislocations and preferential precipitation onto dislocations, and the second stage with effective homogeneous precipitation. The composition of precipitates was identified to be $Be_{11}Fe$, and the crystal structure of the precipitates and their orientation relationship with the matrix were the same as those reported by Rooksby. (auth)

24899 DEPENDENCE OF THE HARDNESS OF BERYLLIUM ON GRAIN SIZE. Bunshah, R. F. (Univ. of California, Livermore); Armstrong, R. W. Mater. Res. Bull., 4: 239-50(Apr. 1969).

The Brinell (BHN) and Rockwell (B and K) hardness were measured for high-purity polycrystalline beryllium having grain sizes in the range between 90 and 600 microns. For each type of test, the hardness H depended on the average grain diameter l, in accordance with the relationship, $H = H_0 + K_H l^{-\frac{1}{2}}$, where H_0 and K_H are experimental constants. The hardness values were lower than those previously reported for impure material, in agreement with a similar difference in the reported yield stress measurements. Metallographic examination of the indentations showed that considerable plastic flow occurred around them. No cracking was observed. (auth)

24900 THE HARDENING OF Fe–Mo SINGLE CRYSTALS BY NON-DEFORMING PRECIPITATED PARTICLES. Yamagata, Toshihiro; Yagisawa, Kohei; Yoshida, Hidehiko (National Research Inst. for Metals, Tokyo). Trans. Jap. Inst. Metals, 10: 45-51(Jan. 1969).

Single crystals of iron base molybdenum alloys containing a high volume fraction of precipitated particles Fe_2Mo noncoherent with the matrix were extended at various temperatures between −110° and 200°C. Critical resolved shear stresses in these single crystals depended on the particle size, mean interparticle spacing, and deformation temperature, but not on the crystal orientation of the single crystals used. The increment of the macroscopic yield stresses by the precipitated particles was obtained by subtracting the solid solution strengthening of the matrix from the observed yield stresses in the aged specimens. It was found that the stress increment by the noncoherently precipitated particles was explained fairly well by the Orowan's mechanism in this alloy system. At the initial stage of plastic deformation, neither primary nor cross slip lines could be resolved by replica-electron microscopy. On the other hand, at a large strain of about 8%, cross slips were clearly observed to take place over a distance of the order of particle size. The changes in crystal orientation with extension were barely perceptible in the over-aged Fe–10% Mo alloys, probably less than 1 degree even after 10% elongation. The increases in flow stress due to work hardening seemed to be independent of the crystal orientation of aged specimens and deformation temperature. This can better be described in terms of a secondary slip theory by Ashby than a model proposed by Fisher et al. (auth)

24901 INVESTIGATION OF THE INITIAL STAGES OF PLASTIC DEFORMATION OF POLYCRYSTALLINE MOLYBDENUM BY MEASUREMENTS OF MICROSTRAINS. Zingsheim, Horst Peter (Metallwerk Plansee Aktiengesellschaft, Reutte, Ger.). Z. Metallk., 60: 282-7(Apr. 1969). (In German).

Microstrain measurements were carried out on molybdenum sheet specimens which were either polygonized or recrystallized state. Data were determined on plastic microstrain, irreversible work of deformation and internal friction by closed hysteresis loops measured in tension. In its common form, evaluation of data from such measurements is criticized and a new method is proposed. By strictly phenomenological reasoning the characteristic features of closed hysteresis loops in the microstrain region can be derived. Their appearance does not imply a specific deformation mechanism. The results of the damping measurements are tentatively interpreted in terms of deformation processes. (auth)

24902 SOME PROPERTIES OF Cu–Cr–Hf ALLOYS. Suzuki, Hisashi; Kanno, Motohiro; Kawakatsu, Ichiro (Tokyo Univ.). Nippon Kinzoku Gakkaishi, 33: 174-8(1969). (In Japanese).

Mechanical and electrical properties in various aged states of Cu–Cr–Hf alloys containing about 0.6% Cr and 0.14 ~ 0.90% Hf were studied in comparison with those of Cu–Cr–Zr and Cu–Cr alloys. The relations between properties and microstructures were also studied by using the transmission electron microscope. The specimens were cast, hot-worked, solution-treated at 950°C for 1 hr, quenched, and finally cold-reduced about 83% to 0.5 mm-thick sheets. It was found that Cu–Cr–Hf alloys were age-hardened at 400 ~ 450°C. The age-hardenability was shown to be caused by precipitation of Cr-rich phases and Cu–Hf compounds. The Cu–Hf compound precipitated on the {111} habit plane of the matrix. The alloys containing about 0.6% Cr and 0.2 ~ 0.6% Hf exhibited properties of more than 60 kg/mm² in strength and about 80% international annealed copper standard in electrical conductivity, when aged at 400 ~ 450°C for about 3 ~ 20 hr. The Cu–Cr–Hf alloys were considered to be superior to Cu–Cr alloys and equivalent or somewhat inferior to Cu–Cr–Zr alloys. (auth)

24903 EFFECT OF RESIDUAL GASES ON THE EVAPORATION OF TITANIUM UNDER VACUUM [DURING VACUUM MACHINING]. Ivanov, L. I.; Kudryavtsev, N. S. Fiz. Khim. Obrab. Mater., No. 4, 166-8(July-Aug. 1968). (In Russian).

The rate of evaporation of Ti samples under vacuum was studied as a function of the concentration of residual gases at 1200 to 1600°C (residual gas pressures 10^{-8} to 10^{-5} torr). The rate of evaporation varied sharply with both residual pressure and the nature of the gases producing this. In the absence of oil vapor, however, the effect of residual gases became comparatively negligible at pressures below 10^{-7} torr. These results are discussed in relation to the effect of residual gases on the machining of Ti surfaces under vacuum, for which the absence of oil vapor is particularly important. Similar considerations apply to Zr also. (Metals Abstr.)

24904 LOW-DENSITY TANTALUM. Vromen, B. H. Bell Lab. Rec., 46: 326-31(Nov. 1968).

Sputtered Ta films produced at a cathode potential of 1000 to 1500 V have a density of about 12 g/cc, a very porous texture with many fissures, and high resistivity. Exposure of the film to the atmosphere produces an oxide layer which drastically reduces resistivity changes under operating conditions. This finding was used in development of a thermal anodization treatment at high temperatures which produces a uniform, coherent oxide. Potential applications include resistors stable to less than 1% on heavy load tests, thin film capacitors, and integrated circuits. (Metals Abstr.)

24905 WELDABILITY OF A BETA-TITANIUM ALLOY CONTAINING 30 PERCENT MOLYBDENUM. Gurevich, S. M.; Grabin, V. F.; Levandovskaya, S. A.; Kushnirenko, N. A.; Zamkov, V. N. Svar. Proizv., No. 9, 17-18(Sept. 1968). (In Russian).

The welding properties of a Ti–30% Mo alloy were studied because preliminary work showed that its welded joints did not possess the necessary mechanical properties. Welding was carried out with nonconsumable W electrodes in Ar using flux and by electric arc. The welding of this alloy requires an increased welding current and more careful protection by the inert gas than for α- and $(\alpha + \beta)$–Ti alloys. Welds in Ti containing Mo 30 to 32% are not thermally stable in relation to the weld cycle; a second phase forms at the grain boundaries, facilitating a sharp drop in the ductility of the joint. The amount of this second phase decreases with increase in the rate of cooling, and this increases the impact ductility. Welding should therefore be carried out under conditions of minimal consumption of heat input. The mechanical properties of the welds are improved considerably, becoming comparable to those of the parent metal, by alloying with Zr 4 to 5% or Hf 6 to 9%. (Metals Abstr.)

24906 TOXICITY OF INDUSTRIAL METALS. 2nd EDITION. Browning, E. London, Butterworths, 1969. 391p. 84s.

Metals covered include Be, B, Cd, Ce, Cs, Nb, Ge, La, Li, Mg, Mo, Rh, W, V, Zr, etc. (UK)

24907 DEFECTS AND RADIATION DAMAGE IN METALS. Thompson, M. W. Cambridge, Eng., University Press, 1969. 394p. 120s.

The subject is covered under the following main headings: Introduction; point defects; extended defects; the primary event; the collision cascade; point defects in irradiated metals; point defect clusters in irradiated matals; and impurity damage. (UK)

24908 INFLUENCE OF SURFACE REACTION DIFFUSION AT HIGH TEMPERATURE ON THE FORMATION OF BRITTLE FRACTURES IN TITANIUM ALLOYS. Zwicker, U. Werkst. Korros., 19: 905-9(Oct. 1968). (In German).

Heat-resistant Ti alloys containing Al have a tendency to brittle fracture at high temperature. The optimum elongation decreases with time. Examination of TiAl5Sn2.5, TiAl6V4, TiAl7Mo4, and TiAl9V3 alloys by scanning electron probe microanalysis showed Al enrichment at the surface, mainly along the grain boundaries, caused by reaction with the atmosphere. A super-lattice of α-solid solution is formed which exhibits a different deformation mechanism from the α-solid solution free from super-lattice. In alloys with a polygonal grain, the brittle fractures are intercrystalline. If cold forming occurs before stress at high temperature, the grain boundaries are destroyed, and intercrystalline fracture cannot occur. (Metals Abstr.)

24909 EFFECT OF BETA WORKING ON 6A1-4V TITANIUM ALLOY. Van Orden, J. M.; Soffa, L. L. Technical Report No. D8-24.3. Metals Park, Ohio, American Society for Metals. 1968. 51p.

The results of a structural and metallurgical study of a typical aircraft forging configuration are described. Specimen testing and testing of a full-size forging were conducted to determine the effects of mill forging procedures (both above and below the β transus temperature), grain direction, section size, microstructure and heat treatment condition on tensile and fatigue properties. Smooth and notched tensile and fatigue tests also were conducted on electron beam welded specimens and, finally, a full-sized forging was fatigue tested under simulated service spectrum conditions. (Metals Abstr.)

24910 MECHANICAL BEHAVIOUR OF AN Fe-11 AT. PERCENT Mo ALLOY IN THE TEMPERATURE RANGE 295 TO 1100°K. Rawlings, R. D.; Newey, C. W. A. (Imperial Coll. of Science and Tech., London). Phys. Status Solidi, 32: 447-54 (Mar. 1, 1969).

The effect of precipitation of an intermetallic compound on the mechanical behavior of an Fe-11 at. % Mo alloy has been studied by means of compression tests in the temperature range 295 to 1100°K. At temperatures up to 700°K for the well-aged conditions of the alloy and 875°K for the solution-treated and slightly aged states, the temperature dependence of the yield and 0.2% proof stresses can be accounted for by the change in the elastic modulus with temperature. For the well-aged conditions in the temperature range 700 to 950°K, the yield strength was temperature and strain-rate sensitive. It is concluded that, in this temperature range, deformation is determined by the diffusion-controlled motion of dislocations past the precipitate barriers. Above about 950°K, all conditions of the alloy exhibited a similar, and large, temperature dependence of the yield strength; in addition, secondary creep occurred at the imposed strain rate and the creep stress was found to be independent of the size and distribution of the precipitate. The very high values of the apparent activation energy for yield and secondary creep found above 950°K are considered to be due to an anomalous change in the activation energy for diffusion during the Curie transformation. (auth)

24911 CRACK PROPAGATION BEHAVIOR OF ZIRCALOY-2. James, Lee A. (Battelle Memorial Inst., Richland, Wash.). Nucl. Appl., 6: 307-12(Apr. 1969).

The fatigue crack growth rate behavior of Zircaloy-2 was determined at room temperature for three material conditions: annealed, hydrided annealed, and 35% cold-worked. The crack growth behavior was found to obey the "power law" of crack propagation. Usage of the data is discussed, and a hypothetical example for estimating the fatigue life of a flawed component is given. (auth)

24912 STUDY OF ELECTROLYTIC DEPOSITS FOR WELDING BY DIFFUSION. APPLICATIONS IN THE NUCLEAR FIELD. Chauvin, G.; Coriou, H.; Hardy, J.; Mallen, J.; Weisz, M. (Centre d'Etudes Nucleaires, Saclay, France). Mem. Sci. Rev. Met., 66: 67-73(Jan. 1969). (In French).

Electrolytic deposits of silver and copper for welding by diffusion on beryllium are studied. The surface treatment, electrolytic deposition, and thermal diffusion treatment processes are given. Copper and nickel deposition on a Fe-Al alloy is discussed. The application to the welding of Be cans and Fe-Al alloy parts is summarized. (J.C.W.)

24913 Zr Hf NEWSLETTER, APRIL 1969. Akron, N. Y., AMAX Specialty Metals, Inc., 1969. 12p.

Experimentation with hafnium and alloys is reported. Progress on carburization, oxidation resistance, self diffusion, and strength properties is reported. Zirconium-base alloys applied in the nuclear technology are listed and recently published equilibrium diagrams of Nb-V-Zr at 500, 700, and 1000°C and Mo-Nb-Zr at 600 to 1600°C are cited. Zirconium as an alloying element with Al, Cu, Mg, Nb, Ti, U, or Zn improves many properties. New production processes are cited and the fabrication, production, and properties of hafnium and zirconium carbides, oxides, and nitrides are summarized. (131 references) (J.C.W.)

24914 TUNSTEN-BASE ALLOYS. Chang, Winston H. (to General Electric Co.). U. S. Patent 3,434,829. Mar. 25, 1969. Filed Dec. 21, 1966.

A tungsten-base alloy consisting of 20 to 30% Re, 0.5 to 2.0% Nb, and 0.01 to 0.2% carbon is described. (J.C.W.)

24915 THE EXPERIMENTAL RESEARCH ON THE BRITTLENESS DUE TO HEATING HISTORY IN MANUFACTURE AND THE RADIOGRAPHIC INSPECTION OF THE PART FITTED WITH A NOZZLE OF THE PRESSURE VESSEL FOR REACTOR. 2. Yosetsu Gijutsu, 17: 69-91(Jan. 1969). (In Japanese).

The standard V-notch Charpy test and the press-notch Charpy test were carried out on steel plates subjected to hot press, quenching and temper, or annealing, and the test results correlated with results of wide sample testing. The brittle fracture characteristics of welded joints were studied. Deep notch tests were performed as the large sample test for investigating characteristics of the brittle fracture origination. Double tensile tests with temperature gradients were carried out to study the effects of heating and various heat treatments on the ability to prevent the propagation of brittle fracture. The tensile test on long samples and the breaking test of a cylindrical vessel were performed to determine the breaking strength and the deformation up to the breaking point of the pressure vessel composed of materials subjected to hot pressing, welding, stress-relief annealing, and to internal pressure. The fatigue strength of A302B steel subjected to various heating histories was determined by fatigue testing which included high cycle plane bending, low cycle alternating axial load and controlled strain, high cycle alternating axial load and controlled load, and high cycle pulsating axial load. (NSA of Japan)

24916 CONSIDERATIONS ON HOT PRESSING OF POWDERS. Amato, I. (FIAT, Turin); Colombo, R. L. Met. Ital., 61: 24-7(Jan. 1969). (In Italian).

Theories on the mechanism of sintering and hot pressing of powders have been examined. In order to ascertain the validity of some theories in respect to others, some determinations are examined regarding the porosity present in sintered and hot pressed molybdenum and uranium dioxide samples. The main difference noted between sintered and hot pressed samples is that in sintered pellets the inversion point and, open porosity-closed porosity is irrespective of the method used for obtaining the pellets of that density. In the hot pressed samples the inversion point depends on the pressure at which the samples have been obtained. (tr-auth)

24917 TUNGSTEN NEWS, MARCH 1969. Tungsten News, 18p.(Mar. 1969).

The application of tungsten in nuclear-powered Brayton-cycle systems for space applications requiring electric power in the range of tens of kilowatts to megawatts now seems likely. The application of tungsten metal and its desirable properties is discussed. Recent progress on the research and uses of tungsten carbides is summarized. Copper-infiltrated tungsten is used in the manufacture of electrodes or electrochemical machining tools. Recent research on other tungsten-base alloys is discussed. The volatilization of rare-earth metals and thorium from tungsten during arc welding in protective-gas atmospheres was studied. Tungsten as an alloying element is applied in tool steels. The properties and uses of stainless steel, nickel-base alloys, molybdenum-base alloys, and iron-base alloys with tungsten as an additive are summarized. Others studied include cobalt-base alloys, tantalum-base alloy, and niobium-base alloys. Methods for recovering W are listed. Formulas of known isopolytungstates are given. New patents on tungsten oxides are listed. Reference is made to the development of a new fuel cell with a tungsten-carbide catalyst utilizing commercial gas. A list of 188 references is included. (J.C.W.)

24918 COBALT SUPERALLOYS. II. RELATIONSHIP OF PROPERTIES TO MICROSTRUCTURE IN COBALT-BASE SUPERALLOYS. Sullivan, C. P.; Varin, J. D.; Donachie, M. J. Jr. (Pratt and Whitney Aircraft, Middletown, Conn.). Metals Eng. Quart., 9: No. 2, 16-29(May 1969).

Information is reviewed on effects of various elements on Co-base superalloys, nominal compositions of common superalloys, phases in these alloys, intermetallic precipitation and stability, grain structure, element addition effects, high temperature potentials, melting and casting, and fatigue of the alloys. (J.R.D.)

24919 NITRIDE HARDENING OF A MOLYBDENUM–TITANIUM ALLOY BY GLOW DISCHARGE. Hay, M. G.; Martin, J. W. (Oxford Univ.). J. Less-Common Metals, 18: 27-33(May 1969).

A cathode glow discharge unit has been constructed capable of heating 3 mm-dia disk specimens to 1450°C. An alloy of molybdenum-0.96 wt % titanium has been ion-nitrided at 1300°C, and a two and a half times increase in the rate of nitriding has been observed compared with the rate obtained by conventional nitriding techniques. The method had a high penetrative power: nitriding took place equally on the lower surface of the disk in contact with the cathode as on the upper surface. The titanium nitride was observed to have precipitated with plate-like morphology with a $\{114\}_{Mo}$ habit plane. (auth)

24920 ELECTROMIGRATION AND THERMOMIGRATION IN GAMMA URANIUM. D'Amico, John Francis. Troy, N. Y., Rensselaer Polytechnic Inst., 1968. 130p.

Thesis.

Atom transport in gamma-uranium due to the influence of large direct currents (electromigration) and thermal gradients (thermomigration) was measured by observation of local dimensional changes in high-purity uranium rods which were resistively heated with dc or ac in high vacuum. Mass transport was observed toward the anode, with Z^*/f = to -1.6 ± 0.1. Plots of $\log(DZ^*/f)$ vs $1/T$ were found linear with an activation energy of 27.2 ± 0.6 kcal/mole, a value not significantly different from the activation energy for self-diffusion, 26.7 ± 0.9. Thus Z^* is found temperature independent within the accuracy of the experiments. The small negative value of Z^* indicates that the momentum exchange force due to atom-electron collisions dominates slightly over the other electromigration forces. In the thermomigration experiments, mass transport was observed toward the cooler regions, with Q^*/f equal to $+4.7 \pm 0.7$ kcal/mole. Applying the simple kinetic model, and assuming a vacancy mechanism, this value of Q^*/f gives vacancy migration and formation enthalpies of approximately 15.8 and 10.9 kcal/mole, respectively. The vacancy fraction at the melting point determined from the stated value of vacancy formation enthalpy is approximately 2%. Plots of $\log(DQ^*/f)$ vs $1/T$ were found linear with an activation energy of 23.0 ± 1.8 kcal/mole, a value slightly less than that obtained for self-diffusion. No changes in diffusion rate were observed during the course of the experiments, indicating that the defects responsible for the diffusion are quite stable and cannot be annealed out. The diffusion mechanism cannot be definitively determined from these experiments. (Disser. Abstr.)

24921 SELECTING METAL TUBING FOR FLEXING APPLICATIONS. Bean, James D. (Superior Tube Co., Norristown, Pa.). Metal Progr., 95: 138; 140; 142; 150; 152; 154 (Apr. 1969).

Metal tubing is widely used in flexing applications because it absorbs vibration, compensates for thermal expansion, or absorbs the motion of other components in the apparatus. Such a use for a metal tube experiences fatigue and failure. Fatigue resistance depends upon corrosion resistance. Two alloys studied for application in aerospace requirements are the iron-base Almar-362 and AM350. Mechanical properties are given for the precipitation-hardening alloys. (J.C.W.)

24922 THIN CHROMIUM LAYER RAISES PROPERTIES OF BERYLLIUM COMPACT. Morana, Simon J.; Jagaciak, George J. (Kawecki Berylco Industries Inc., Hazleton, Pa.). Metal Progr., 95: 132-6(Apr. 1969).

The decomposition of a uniformly thin layer of chromium on the surface of beryllium powder compacts improves dimensional stability and tensile strength over a wide range of temperatures. Heat treatments lowers the strength, but improves the ductility of surface-coated powder compacts. Microprobe studies were conducted to describe the mechanisms. (J.C.W.)

24923 DEVELOPMENT OF A Co–W FERROMAGNETIC, HIGH-TEMPERATURE STRUCTURAL ALLOY. Ashbrook, R. L.; Hoffman, A. C.; Sandrock, G. D.; Dreshfield, R. L.; Freche, J. C. (Lewis Research Center, Cleveland). Cobalt, 123-30(Sept. 1968).

Description of a new Co–W alloy for the rotor material used in turboelectric space power conversion systems is given. The alloy, Co-7, 5W-2.5Fe-1Ti-0.5Zr-0.5C, has improved high-temperature stress-rupture properties above 1200°F and magnetic properties comparable to the strongest known commercially available high-temperature magnetic alloy. The matrix of the alloy is an fcc solid solution of cobalt, containing monocarbides and possibly complex carbides. Varying amounts of hcp cobalt are also present at room temperature, depending on the heat treatment used. (IAA)

24924 A LOOK AT WORLDWIDE TITANIUM TECHNOLOGY. Gray, Allen G. Metal Progr., 94: No. 3, 60-71(Sept. 1968).

The industries which use the present supply of Ti are enumerated. Properties discussed include casting, density, and strength. Fabrication, forging, and heat treatment are reviewed. Design criteria for Ti alloys are discussed in relation to temperature. (J.C.W.)

24925 AN ANALYSIS OF THE CREEP BEHAVIOUR OF IRON–MOLYBDENUM SOLID SOLUTIONS. Fuchs, A.; Ilschner, B. (Univ., Erlangen, Ger.). Acta Met., 17: 701-10(June 1969).

Specimens of iron base alloys with up to 4.3 at. % molybdenum have been strained between 500 and 1000°C at constant load corresponding to 0.5 to 20 kg/mm² tensile stress. Stress and temperature dependence of the stationary creep rate have been determined using a technique of repeated load and temperature changes with an appropriate evaluation. A single function, $\dot{\epsilon} \sim \sigma^3 \sinh(V\sigma/kT)$, represents in good approximation all creep rate data over the whole stress range, including literature data for pure iron. V is independent of strain, but decreases with increasing Mo content. Within narrow stress intervals, the above function may be approximated by simple power laws with stress exponents varying from 4 (low stress) to about 20 (high stress). The activation energy for creep, after proper correction, shows a pronounced peak at the Curie temperature, and approaches 65 kcal/mole above 850°C, but 100 kcal/mole below 650°C. Further results are given on the stress dependence of the substructure parameters as well as on the nature of transient creep within different stress regions. (auth)

24926 THE DUCTILE–BRITTLE TRANSITION IN POLYCRYSTALLINE MOLYBDENUM. Wronski, A. S.; Chilton, A. C.; Capron, E. M. (Univ. of Bradford, Eng.). Acta Met., 17: 751-5(June 1969).

The fracture stress at the ductile-brittle transition temperature of polycrystalline molybdenum was found to be constant, 64 ± 2 kg mm^{-2}, as the strain rate was raised from 5×10^{-6} to 5×10^{-2} sec^{-1}. It is suggested that only above the transition temperature is crack nucleation easier than crack propagation and that brittle fracture takes place at the crack nucleation stress. At the transition temperature the stresses for yielding, crack nucleation and crack propagation are thought to be equal. Assuming simple phenomenological correlations between yield stress and temperature, strain rate and grain size, respectively, an analysis of the dependence of the ductile-brittle transition temperature on strain rate, neutron irradiation, pressurization and grain size is presented. This analysis should be applicable to the other Group VIa bcc transition metals such as chromium and tungsten, which appear to exhibit similar behavior. (auth)

Structure and Phase Studies

Refer also to abstracts 24855, 24892, 24896, 24902, 24956, and 25253.

24927 (RT/MET–(68)5) STUDY OF TERNARY ALLOYS OF URANIUM–MOLYBDENUM–NIOBIUM AND URANIUM–MOLYBDENUM–ZIRCONIUM AT LOW CONTENT OF BINDER. Fizzotti, C.; Masperoni, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 79p. (In Italian). Dep.

In order to improve the irradiation resistance of metallic uranium, ternary alloys containing Mo + Nb and Zr + Mo were investigated. The structures obtained in these alloys by different heat-treatments were characterized by long-term annealing, thermal cycling, and mechanical tests. Isothermal sections of the ternary system U–Mo–Nb are also shown. A few of these heat-treated alloys were selected for irradiation tests. (auth)

24928 STUDY OF FACETTING OF TUNGSTEN SINGLE CRYSTAL SURFACES. Tracy, J. C.; Blakely, J. M. (Cornell Univ., Ithaca, N. Y.). Surface Sci., 13: 313-36(Feb. 1969).

Thermal facetting of the (100), (112), and (111) surfaces of tungsten to {110} planes is observed in the presence of oxygen at pressures between 10^{-8} and 10^{-4} torr using a vibrating capacitor work function probe in conjunction with low-energy electron

diffraction (LEED). The (110) surface is stable against facetting under the same conditions. The work function of the facetted surfaces for the three planes indicated is the same as that of an oxygen covered (110) surface and is equal to 6.45 eV. A (112) surface containing periodic {110} facets only 20 Å wide has the same 6.45 eV work function as an oxygen covered (110) plane. A diffraction analysis is presented which allows the determination of the indices of the facet planes from the voltages at which very intense primary maxima occur and the symmetry of the pattern at intermediate voltages. For simple facet planes the primary maxima correspond to bulk Laue reflections. The kinetics of facet growth on the (112) surface are characterized by a low-temperature W–O coupled diffusion-controlled region and a high-temperature region controlled by oxygen supply to dissociation sites. (auth)

24929 METALLOGRAPHIC INVESTIGATIONS ON THE PRIMARY RECRYSTALLIZATION OF MOLYBDENUM AND TUNGSTEN. Pink, E. (Metallwerk Plansee AG, Reutte/Tirol, Austria). Planseeber. Pulvermet., 16: 277-82(Dec. 1968). (In German).

Temperature and time dependence for the first variation of deformation structure serration of grain boundaries as well as for the onset and termination of primary recrystallization in Mo, Mo-0.5 Ti and W was established by means of metallographic investigations. (tr-auth)

24930 TERNARY SYSTEM CHROMIUM–RHENIUM–BORON. Telegus, V. S.; Kuz'ma, Yu. B.; Stefanishina, Ts. K. (Lvov State Univ.). Porosh. Met., Akad. Nauk Ukr. SSR, No. 2, 64-9 (Feb. 1969). (In Russian).

The system Cr–Re–B was investigated by means of x-ray diffraction and microstructure analyses. The phase equilibria were established at 1400°C. The compound Cr_2B dissolved 50 at. % Re. In the system Cr–Re–B the ternary compound $Cr_3Re_2B_5$ with the structure of the FeB type (a = 5.698 + 5.749 ± 0.005, b = 2.959 + 2.973 ± 0.003, c = 4.261 + 4.297 ± 0.003 Å) was found. In the cast alloys the compound $CrRe_3B_{4-x}$ existed with the structure of the α–MoB type (a = 2.997 ± 0.002, c = 16.515 ± 0.01 Å c/a = 5.511). (auth)

24931 THE KINETICS OF ISOTHERMAL TRANSFORMATIONS IN NICKEL–20.8 AT. PERCENT MOLYBDENUM AND NICKEL–16.7 AT. PERCENT MOLYBDENUM ALLOYS. Dubrovina, A. N.; Umansky, Ya. S. pp 100-4 of Diffuzionnye Protsessy v Metallakh. Kiev, Nauk Dumka, 1968. (In Russian).

A study was made of the isothermal transformation kinetics in two Ni–Mo alloys containing 20.8 and 16.7 at. % Mo, respectively. The annealing at 700 to 800°C of both these alloys, quenched from the single-phase (γ) region, led to the formation of the Ni_4Mo ordered phase by means of a heterogeneous recrystallization transformation. The number of ordering centers was greater, although their dimensions were smaller, the greater the degree of supercooling of the alloy. Increase in the quantity of Ni_4Mo occurred not only by growth of the old centers but also by the formation of new centers. Coalescence of domains at 800°C began when the ordered phase still does not occupy the greater part of the volume of the alloy. The degree of tetragonality of the lattice in the early stages of transformation was a long way from equilibrium and depended on the annealing temperature. Thus, in the alloy containing 20.8 at. % Mo, the degree of order in the ordered parts of the specimen after a 10 hr anneal at 800°C was higher than for specimens annealed at 700°C despite the fact that the equilbrium value of the degree of long range order at 800°C was no higher than that at 700°C. (Referativnyi Zh.)

24932 INVESTIGATION OF THE TERNARY SYSTEM ZIRCONIUM–RHENIUM–CARBON. Gorshkova, L. V.; Voroshilov, Yu. V.; Fedorov, T. F. (Lvov State Univ. Inst. of Metallurgy, Moscow). Porosh. Met. Akad. Nauk Ukr. SSR, No. 2, 82-5(Feb. 1969). (In Russian).

An isothermal section of the Zr–Re–C system at 1900°C was plotted by analysis of microstructure, x-ray diffraction phase analyses, and by measurement of hardness and resistivity of melted alloys of this system. At this temperature the binary compounds of the Zr–Re system and the components Zr, Re, and C were in equilibrium with zirconium carbide ZrC. Ternary compounds were not found in the system. The ZrC–Re system was a quasibinary one of the eutectic type with eutectics about 70 at. % Re. The solubility of Re in ZrC was equal to 1.5 at. %. Combined solubility of zirconium and carbon in rhenium was less than 1 at. %. The concentration dependences of hardness and resistivity in the ZrC–Re system were studied. (auth)

24933 COBALT SUPERALLOYS. I. MICROSTRUCTURE OF COBALT-BASE HIGH-TEMPERATURE ALLOYS. Morral, F. R. (Battelle-Columbus Labs., Columbus, Ohio); Habraken, L.; Coutsouradis, D.; Drapier, J. M.; Urbain, M. Metals Eng. Quart., 9: No. 2, 1-16(May 1969).

Metallographic research on simple binary alloys has been done on diffusion coefficients, stacking faults, and vacancies. Such work has been started on the more complex systems, and even on some commercial alloys. The best values of chemical composition and lattice parameters are necessary on matrix and coexisting phases to permit good correlation with properties and changes occurring in service. It is apparent that considerable work needs to be done to obtain these data. (auth)

24934 INVESTIGATION OF THE Al–Be ALLOY WITH Y, La, AND Ce ADDITIONS UP TO 33.3 AT. PERCENT. Zarechnyuk, O. S.; Vivchar, O. I.; Frankevich, D. P. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met., No. 1, 122-5(1969). (In Russian).

A study was made of the systems Y–Be–Al, La–Be–Al, and Ce–Be–Al with rare earth additions from 0 to 33.3 at. %. Samples prepared from the alloys were subjected to homogenizing annealing at 500°C for periods of 100 hr with subsequent quenching in toluol. The studies showed that after 200-hr annealing at 500°C in the Ce–Be–Al system the equilibrium $CeAl_3$ + D was fixed and that the D phase of the Ce–Be–Al system, in constrast to the D phases of the La–Be–Al and Y–Be–Al systems, is actually not in equilibrium with Al. An isothermal cross section of the part of the system studied is given. In all three systems only one ternary compound was observed. There is a similarity between the phase equilibria of the Y–Be–Al and La–Be–Al systems, which differ from the Ce–Be–Al system. Ternary compounds of great similarity were observed between the La–Be–Al and Ce–Be–Al systems. (J.S.R.)

24935 RARE EARTH METAL–METAL HALIDE SYSTEMS. XII. THE THULIUM–THULIUM(III) CHLORIDE SYSTEM. THULIUM(II) CHLORIDE AND A SERIES OF INTERMEDIATE PHASES. Caro, P. E.; Corbett, J. D. (Ames Lab., Iowa). J. Less-Common Metals, 18: 1-10(May 1969).

Thermal analysis, equilibration, and x-ray data are reported for the condensed $TmCl_3$–Tm system. Thulium(II) chloride melts congruently at 718 ± 3°C and is isostructural with $DyCl_2$ and $YbCl_2$ with a_0 = 6.55, b_0 = 6.68, c_0 = 6.93 Å, all ±0.02 Å. The dichloride dissolves in water to give a short-lived, bordeaux-red color. Thermal analysis data give evidence for the presence of about nine intermediate compounds between $TmCl_{2.04}$ and about $TmCl_{2.12}$. Their apparent peritectic interconversions at 662 to 385°C are rapid on both heating and cooling, and a close relationship between these and the parent $TmCl_2$ structure is indicated by their powder patterns. The compounds may be considered as the ordered phases which derive from a hypothetical nonstoichiometric region. (auth)

24936 NEW TETRAGONAL COMPOUNDS Nb_3Si AND Ta_3Si. Deardorff, D. K.; Siemens, R. E.; Romans, P. A.; McCune, R. A. (Albany Metallurgy Research Center, Oreg.). J. Less-Common Metals, 18: 11-26(May 1969).

Small ingots of Nb–Si alloys were made from high-purity, solid-form (not powder) Nb and Si by arc-melting and suction-casting into a copper mold. Samples from these ingots were tested for the presence of a superconducting transition temperature (T_c) and were found to be superconducting (with a T_c near 7.5°K) up to 37.5 at. % silicon. Metallographic and microprobe studies to determine the superconducting phase in the system led to the discovery of an unreported compound, Nb_3Si, and indicated that Nb_4Si does not exist. Further investigation showed that Ta_3Si also exists and that Ta_4Si does not, these alloys being similarly prepared from solid-form, high-purity Ta and Si. Nb_3Si and Ta_3Si were found to have isomorphous tetragonal structures with parameters a_0 = 10.21 ± 0.01 Å, c_0 = 5.19 ± 0.01 Å, and a_0 = 10.17 ± 0.01 Å and C_0 = 5.16 ± 0.01 Å, respectively. The Ta_3Si pattern was found to be nearly identical to one reported for $TaSi_{0.20\pm0.05}$. Nb_3Si was determined to be essentially a line compound which melts peritectically at 1945° ± 20°C. It was found to be nonsuperconducting above 4.2°K. The superconducting phase was determined to be Nb solid solution, which was present as Nb–Nb_3Si eutectic up to 37.5 at. % a Si. (auth)

24937 CADMIUM–NEPTUNIUM: A PARTIAL PHASE DIAGRAM OF THE SYSTEM. Krumpelt, M.; Johnson, I.; Heiberger, J. J. (Argonne National Lab., Ill.). J. Less-Common Metals, 18: 35-40(May 1969).

The phase diagram of the cadmium-rich region of the cadmium–neptunium system has been determined. The solubility of neptunium in liquid cadmium may be expressed by the equations: (320 to 485°C) $\log X_{Np} = 4.099 - 4397T^{-1}$; (485 to 626°C) $\log X_{Np} = 0.4589 - 1636T^{-1}$ where X_{Np} is the atom fraction of Np and T in °K. Two intermetallic compounds were found in this system: $NpCd_{11}$, cubic ($BaHg_{11}$-type), a = 9.288 Å and $NpCd_6$, cubic ($CeCd_6$-type) a = 15.614 Å. At 485°C, $NpCd_{11}$ peritectically decomposes into $NpCd_6$ and a liquid Cd-2 at. % Np solution. (auth)

24938 CRYSTAL STRUCTURES OF AB_3 AND A_2B_7 RARE EARTH–NICKEL PHASES. Virkar, A. V.; Raman, A. (Louisiana State Univ., Baton Rouge). J. Less-Common Metals, 18: 59-66(May 1969).

The structural data of several nickel-rich rare earth-nickel phases are reported. Excepting $CeNi_3$, the other $LnNi_3$-phases crystallize with the $PuNi_3$-type structure. Both the Ce_2Ni_7- and Gd_2Co_7-type structures occur in several Ln_2Ni_7-phases. Ce_2Ni_7 possesses only the Ce_2Ni_7-type structure. Three modifications are encountered for Nd_2Ni_7. The low-temperature form is of the Ce_2Ni_7-type. The high-temperature forms are found to possess large periodicities along the C_0-direction. Nd_2Ni_{17} has the Th_2Ni_{17}-type structure at high temperatures. (auth)

24939 STANDARD SINGLE-CRYSTAL ELECTRON-DIFFRACTION PATTERNS OF THE HEXAGONAL PHASES α' AND ω IN ZIRCONIUM ALLOYS. Chaturvedi, M.; Singh, R. N. (Univ. of Manitoba, Winnipeg). J. Less-Common Metals, 18: 71-7(May 1969).

An index is given of the electron-diffraction patterns of the hexagonal α' and ω phases of Zr–2.5 wt % Nb and Zr alloys respectively. Standard single-crystal diffraction patterns are a two dimensional section of the reciprocal lattice in various orientations with respect to the electron beam drawn at a magnification corresponding to the camera constant $L\lambda$ of the microscope where L is the camera length and λ is the wavelength of the electron beam. (J.C.W.)

24940 PRECIPITATION OF NITROGEN ON DISLOCATION IN NIOBIUM. Dollins, C.; Wert, C. (Univ. of Illinois, Urbana). Acta Met., 17: 711-18(June 1969).

The kinetics of precipitation of nitrogen in deformed niobium was determined using the Snoek internal friction peak to follow the precipitation. The kinetics followed the well-known rate equation for the fraction, W, of nitrogen precipitated as a function of time, $W = 1 - e^{-(t/\tau)^n}$. The constant n was found to be temperature dependent, having the value 2/3 at the lowest temperature used (300°C) and values around 1 at the higher temperatures, 400 and 500°C. These numbers are correlated with the nature of the precipitates observed in thin film electron microscopy. The predictions of Bullough and Newman concerning the effect on n of discrete and continuous precipitates are well obeyed. (auth)

Radiation Effects

Refer also to abstracts 24402, 24840, 24855, and 24907.

24941 (BARC–360) RADIATION HARDENING EFFECTS IN Zr-BASE ALLOYS. Ray, S.; Sharma, B. D. (Bhabha Atomic Research Centre, Bombay (India)). 1968. 12p. Dep.

Neutron irradiation effects on zirconium-base alloys with particular reference to irradiation hardening and its recovery at high temperature were investigated and compared. Zirconium base alloys including Nb–Zr, Cr–Zr, Cu–Nb–Zr, and Cr–Nb–Zr undergo hardening on quenching from β-phase due to a martensitic reaction. In Cr–Nb–Zr, radiation induced hardening in the as-quenched state was lower than in the as-annealed condition. Niobium addition to zirconium base alloys stabilizes radiation damage. Percentage change in room temperature tensile properties of Zircaloy-2, Cu–Nb–Zr, and Cr–Nb–Zr and tensile property changes in irradiated quenched or/and annealed Cu–Nb–Zr, Nb–Zr, and Cr–Nb–Zr alloys and the effect of irradiation on the tensile properties of annealed Cr–Nb–Zr alloys are given. (F.S.)

24942 (BNWL–870) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, May–July 1968. Claudson, T. T. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1968. Contract AT(45-1)-1830. 268p. Dep. CFSTI.

The report is presented in seventeen sections. A separate abstract was prepared for each of sixteen sections. The section for which no abstract was prepared is concerned with plans for future specimen irradiations in ETR. (J.R.D.)

For abstracts of individual sections see: 24839, 24840, and 24943–24956.

24943 (BNWL–870, pp 3.1-4) THE EFFECTS OF IRRADIATION ON THE TENSILE PROPERTIES OF EBR-II TYPE 304 STAINLESS STEEL. Carlander, R. (Argonne National Lab., Ill.).

EXPERIMENTAL BREEDER REACTOR-II — steel from control rod thimble of, radiation effects at 450°C on tensile properties of Type 304
NEUTRONS, FAST — effects on tensile properties of Type 304 steel
STAINLESS STEEL — radiation effects on tensile properties of Type 304, from EBR-II control rod thimble, flux dependence at 450°C of (L.C.L.)

24944 (BNWL–870, pp 3.4-10) EXAMINATION OF IRRADIATED TYPE 304 SS AND V–20 WT.% Ti BY TRANSMISSION ELECTRON MICROSCOPY. Harkness, S. D. (Argonne National Lab., Ill.).

EXPERIMENTAL BREEDER REACTOR-II — steel from control rod thimble of, TEM examination of irradiated Type 304
NEUTRONS, FAST — effects on microstructure of Type 304 SS and Ti–V alloy, TEM examination of
STAINLESS STEEL — radiation effects on microstructure of Type 304, from EBR-II control rod thimble, TEM examination of
TITANIUM A & S — Ti–V, radiation effects on microstructure of, TEM examination of, fast neutron
VANADIUM A & S — Ti–V, radiation effects on microstructure of, TEM examination of, fast neutron (L.C.L.)

24945 (BNWL–870, pp 3.10-13) MODEL OF VOID FORMATION. Harkness, S. D. (Argonne National Lab., Ill.).

METALLURGY — model of void formation and growth in fast neutron-irradiated structural materials, (T)
NEUTRONS, FAST — effects on void formation and growth in structural materials, model for describing (L.C.L.)

24946 (BNWL–870, pp 4.1-6) EFFECT OF RADIATION ON THE MECHANICAL PROPERTIES OF CLADDING MATERIALS. Kangilaski, M.; Peterson, S. L.; Perrin, J. S.; Wullaert, R. A. (Battelle Memorial Inst., Columbus, Ohio).

COBALT A & S — radioinduced embrittlement at 450, 550, and 650°C of UMCo-50, fast neutron
HAYNES STELLITE No. 25 — radioinduced embrittlement at 450, 550, and 650°C, effects of nickel content on, fast neutron
NEUTRONS, FAST — effects on embrittlement of cladding materials for liquid-metal-cooled fast reactor, at 450, 550, and 650°C
NICKEL — content in fast reactor cladding materials, effects on radioinduced embrittlement at 450, 550, and 650°C of
NICKEL 200 — radioinduced embrittlement at 450, 550, and 650°C, effects of nickel content on, fast neutron
STAINLESS STEEL — radiation effects on stress rupture properties of Type 347, at 650°C, fast neutron
— radioinduced embrittlement at 450, 550, and 650°C of Tenelon, fast neutron (L.C.L.)

24947 (BNWL–870, pp 4.6-8) CORRELATION OF RADIATION EFFECTS ON MECHANICAL PROPERTIES AS CAUSED BY A PREDOMINANTLY FAST FLUX AND A MIXED FAST AND THERMAL FLUX. Kangilaski, M.; Perrin, J. S.; Wullaert, R. A. (Battelle Memorial Inst., Columbus, Ohio).

24948 (BNWL–870, pp 4.8-10) RADIATION EFFECTS ON THE MECHANICAL PROPERTIES OF TYPE 347 SS FERMI WRAPPER TUBE. DeMastry, J. A.; Sheckherd, J. W.; Wullaert, R. A. (Battelle Memorial Inst., Columbus, Ohio).

FERMI FAST BREEDER REACTOR — tubes for, radiation effects on tensile properties of Type 347 SS wrapper, fast and mixed fast-thermal neutrons
NEUTRONS, FAST — effects on tensile properties of Type 347 SS Fermi wrapper tube at 20, 315, and 650°C
NEUTRONS, THERMAL — effects on tensile properties of Type 347 SS Fermi wrapper tube at 20, 315, and 650°C
STAINLESS STEEL — radiation effects on tensile properties of Type 347, from Fermi wrapper tubes, fast neutron and mixed fast-thermal neutron (L.C.L.)

24949 (BNWL–870, pp 4.10-14) DETERMINATION OF THE FRACTURE TOUGHNESS OF SPECIMENS FROM THE PM-2A PRESSURE VESSEL. DeMastry, J. A.; Sheckherd, J. W.; Wullaert, R. A. (Battelle Memorial Inst., Columbus, Ohio).

CRACKS — development of fatigue, in PM-2A pressure vessel fracture toughness specimens at –20 and 72°F
MATERIALS TESTING — methods for determining fracture toughness of PM-2A pressure vessel material
PRESSURE VESSELS — fracture toughness of specimens from PM-2A, (E) (L.C.L.)

24950 (BNWL–870, pp 5.1-2) EFFECT OF MICROSTRUCTURE ON TENSILE PROPERTIES OF IRRADIATED STAINLESS STEEL. Chow, J. G. Y.; Jones, R. (Brookhaven National Lab., Upton, N. Y.).

GRAIN STRUCTURE — effects of Type 304 SS, on high temperature ductility after irradiation
NEUTRONS, FAST — effects on high temperature ductility of Type 304 SS, relation with microstructure
STAINLESS STEEL — radiation effects on tensile properties at 650, 750, and 800°C of cold-swaged and annealed Type 304, relation with microstructure of, fast neutron (L.C.L.)

24951 (BNWL-870, pp 5.2-4) EFFECT OF IRRADIATION ON TENSILE PROPERTIES OF IRRADIATED SUPERPLASTIC Fe-Ni-Cr ALLOYS. Chow, J. G. Y. (Brookhaven National Lab., Upton, N. Y.).

CHROMIUM A & S—Cr-Fe-Ni, radiation effects on tensile properties of superplastic, at 25, 650, and 750°C, fast neutron
IRON ALLOYS & S—Cr-Fe-Ni, radiation effects on tensile properties of superplastic, at 25, 650, and 750°C, fast neutron
NEUTRONS, FAST—effects on tensile properties of superplastic chromium-iron-nickel alloys at 25, 650, and 750°C
NICKEL A & S—Cr-Fe-Ni, radiation effects on tensile properties of superplastic, at 25, 650, and 750°C, fast neutron (L.C.L.)

24952 (BNWL-870, pp 5.4-14) RADIATION HARDENING OF IRON. Soo, P.; Jones, R. (Brookhaven National Lab., Upton, N. Y.).

IRON—radiation effects on tensile properties of Ferrovac-E, flux dependence of, fast neutron
—radiation effects on activation energy for slip in Ferrovac-E, temperature and thermal stress dependence of, fast neutron
NEUTRONS, FAST—effects on tensile properties of Ferrovac-E at 77 to 400°F
—effects on activation energy for slip in Ferrovac-E at 77 to 400°F, temperature and thermal stress dependence of
TEMPERATURE—effects on activation energy for slip in fast-neutron-irradiated Ferrovac-E
THERMAL STRESSES—effects on activation energy for slip in fast neutron-irradiated Ferrovac-E (L.C.L.)

24953 (BNWL-870, pp 9.1-19) RESEARCH PROGRESS. Steele, L. E.; Hawthorne, J. R.; Serpan, C. Z. Jr.; Potapovs, Uldis; Gray, R. A. Jr. (Naval Research Lab., Washington, D. C.).

CHROMIUM A & S—Cr-Mo-Ni-Steel, radioinduced embrittlement of maraging, conditioning-temperature dependence of, fast neutron
LA CROSSE BOILING-WATER REACTOR—pressure vessel steel from, radioinduced embrittlement of
MOLYBDENUM A & S—Cr-Mo-Ni-Steel, radioinduced embrittlement of maraging, conditioning-temperature dependence of, fast neutron
NEUTRONS, FAST—effects on embrittlement of welds of Types A533C-class 2 and A533B-class 1 steel
—effects on embrittlement of chromium-molybdenum-nickel-steel maraging plate, conditioning-temperature dependence of
—effects on embrittlement of thick plate steels for pressure vessels, temperature dependence of
NICKEL A & S—Cr-Mo-Ni-Steel, radioinduced embrittlement of maraging, conditioning-temperature dependence of, fast neutron
PRESSURE VESSELS—steels for reactor, radiation effects research on
STEEL—welds of Type A533C-class and A533B-class 1, effects of fast neutrons on embrittlement of
—Cr-Mo-Ni-Steel, radioinduced embrittlement of maraging, conditioning-temperature dependence of, fast neutron
—radioinduced embrittlement of 6 in. thick Type A302B plate, at −80 to 300°F, fast neutron
—radioinduced embrittlement of 8 in. thick Type A543 plate, at −240 to 120°F, fast neutron
—radioinduced embrittlement of 4 in. thick Type A302B plate, from LaCrosse Boiling Water Reactor pressure vessel, fast neutron
—radioinduced embrittlement of ¾ in. thick Type A537B plate, at −240 to 180°F, fast neutron
WELLS—radioinduced embrittlement of Type A533C-class 2 steel arc, at −120 to 300°F, fast neutron
—radioinduced embrittlement of Type A533B-class 1 steel electroslag, at −120 to 300°F, fast neutron (L.C.L.)

24954 (BNWL-870, pp 10.1-12) RADIATION EFFECTS ON FAST REACTOR CLADDING AND STRUCTURAL MATERIALS. Moteff, J. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation).

ANNEALING—effect of high temperature, on electrical resistivity of irradiated molybdenum
HASTELLOY-X—radiation effects on creep-rupture at 540°C of, fast neutron
INCOLOY 800—radiation effects on creep-rupture at 705°C of, in-reactor time dependence of, fast neutron
MOLYBDENUM—radiation effects on creep-rupture at 1000°C of, irradiating temperature dependence of, fast neutron
—radiation effects on electric resistivity of, annealing temperature dependence of, fast neutron
NEUTRONS, FAST—effects on creep-rupture at 705°C of Incoloy 800, in-reactor time dependence of
—effects on creep-rupture of Hastelloy-X at 540°C
—effects on low cycle plastic fatigue of Type 316 SS at 650°C
—effects on creep-rupture of molybdenum at 1000°C, irradiation temperature dependence of
—effects on electric resistivity of molybdenum, annealing temperature dependence of
—effects on microstructure of vanadium, transmission electron microscopy measurements of
STAINLESS STEEL—radiation effects on low cycle plastic fatigue of Type 316, at 650°C, fast neutron
TEMPERATURE—effects of irradiation, on creep-rupture properties of molybdenum
VANADIUM—radiation effects on microstructure of, transmission electron microscopy measurements of (L.C.L.)

24955 (BNWL-870, pp 11.1-90) RADIATION METALLURGY Billington, D. S.; Wechsler, M. S. (Oak Ridge National Lab., Tenn.).

ANNEALING—effects of post-irradiation, on property changes due to impurities in zone-refined niobium
AUTORADIOGRAPHY—method for determining inhomogeneous distribution of titanium and tungsten in zone-refined niobium
HASTELLOY N—radiation effects on creep properties of titanium-modified, thermal neutron
HELIUM—effect of cyclotron-injected, on creep-rupture properties of Type 304 SS and titanium-modified Type 304L
INCOLOY 800—radiation effects on tensile properties of, grain size dependence of, thermal neutron
NEUTRONS, FAST—effects on property changes in post-irradiation annealed zone-refined niobium containing impurities
—effects on tensile properties of regular and titanium-modified Type 316 SS, temperature dependence of
—effect on mechanical properties of titanium-modified Type 304 SS
—effects on void density in Type 304L SS, irradiation temperature and flux dependence of
—effects on void density of vanadium
NEUTRONS, THERMAL—effects on tensile properties of regular and titanium-modified Type 316 SS, temperature dependence of
—effect on mechanical properties of titanium-modified Type 304 SS
—effects on tensile properties of Incoloy 800, grain size dependence of
—effects on creep properties of titanium-modified Hastelloy N
NIOBIUM—radiation effects on microstructure of zone-refined, impurity dependence of, fast-neutron
—titanium and tungsten distribution in zone-refined, microradiographic detection of inhomogeneous
—property changes in post-irradiation annealed zone-refined, effects of impurities on
—annealing of irradiated, effects of oxygen on
—internal friction of hairpins of, effects of measuring temperature on
—dislocation channels in irradiated and plastically deformed, micrographs of
OXYGEN—effect on annealing of irradiated niobium
STAINLESS STEEL—radiation effects on tensile properties of Type 316 and titanium-modified Type 316, temperature dependence of, fast and thermal neutron
—radiation effects on mechanical properties of titanium-modified Type 304, fast and thermal neutron
—tubes of titanium-modified Types 304 and 304L, method for producing
—creep-rupture of Type 304 and titanium-modified 304L, effect of cyclotron-injected helium on
—radiation effects on void density in Type 304L, irradiation temperature and flux dependence of, fast neutron
TEMPERATURE—effects of post-irradiation annealing, on resistance of zone-refined irradiation niobium
—effects of measuring, on internal friction of niobium hairpins
—effect on radiation hardening, use of continuum theory for determining
—effects of irradiation, on void density of irradiated Type 304L SS
TITANIUM—distribution in zone-refined, microradiographic detection of inhomogeneous
—content in modified Type 316 SS, effect on pre- and post-irradiation creep-rupture ductility of

—effect on mechanical properties of modified and irradiated Type 304 SS
—effects on pre- and post-irradiation creep properties of modified Hastelloy N
TUBES—production of titanium-modified Types 304 and 304L SS, method for
TUNGSTEN—distribution in zone-refined, microradiographic detection of inhomogeneous
VANADIUM—radiation effects on void density of, fast neutron (L.C.L.)

24956 (BNWL-870, pp 12.1-55) IRRADIATION DAMAGE TO REACTOR METALS. Bement, A. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

ANNEALING—effect of duration of, on void size distribution in irradiated nickel at 600° annealing temperature
—effects on microstructure of fast neutron-irradiated single-crystal and polycrystalline molybdenum
BORON OXIDES—radiation effects on microstructure of high pressure forms of, fast neutron
COMPUTER PROGRAMS—REM, for processing information on LMFBR cladding materials
DEUTERIUM—effusion in Type 304L SS, effect of deformation temperature on
HASTELLOY X—radiation effects on stress-rupture at 1000°C, in-pile
HEAT TREATMENT—effects of "stress-aging," on tensile properties of Type 304 SS at 20 and 1000°C
HELIUM—effect on microstructure of powdered nickel sintered at 800°C
INDIUM A & S—radiation effects on microstructure of high pressure forms of, fast neutron
LABORATORY EQUIPMENT—construction status of, for evaluating radiation effects on reactor materials in sodium and controlled gas atmospheres, at Battelle-Northwest
LEAD OXIDES PbO_2—radiation effects on microstructure of high pressure forms of, fast neutron
MOLYBDENUM—annealing behavior of fast neutron-irradiated single-crystal and polycrystalline
NEUTRONS, FAST—effects on tensile properties of Type 348 SS at 20 to 750°C
—effects on creep-rupture of Type 304 SS at 650°C in air
—effects on microstructure of Type 304 SS, irradiation temperature dependence of
—effects on microstructure of sodium environment-irradiated Type 316SS, test temperature dependence of
—effects on microstructure of various high pressure polymorphs
—effects on high-pressure polymorphs of lead oxide
—effects on high-pressure polymorphs of boron oxide
NICKEL—microstructure of powdered, sintered at 800°C, effect of helium on
—void size distribution in irradiated, at 600°C annealing temperature, effect of annealing time on
NIOBIUM A & S—Nb-Zr, radiation effects on stress-rupture at 300°C, in-pile
PHOSPHORUS—radiation effects on microstructure of high pressure forms of, fast neutron
PRESSURE VESSELS—radiation effects on fracture-toughness of steels for, research on
SILICON OXIDES—radiation effects on microstructure of high pressure forms of, fast neutron
STAINLESS STEEL—radiation effects on tensile properties of Type 348, at 20 to 750°C, fast neutron
—radiation effects on creep-rupture of Type 304, tested at 650°C in air, fast neutron
—radiation effects on microstructure of Type 304, irradiation temperature dependence of, fast neutron
—radiation effects on microstructure of sodium environment-irradiated Type 316, test temperature dependence of, fast neutron
—tensile properties at 20 and 1000°C of Type 304, effects of "stress-aging" on
—deuterium effusion characteristics of Type 304L, effect of deformation temperature on
STEEL—fracture-toughness of 12 in. thick Type A533B plate, effect of test temperature on
TELLURIUM A & S—radiation effects on microstructure of high pressure forms of, fast neutron
TEMPERATURE—effects of irradiation, on changes in Type 304SS microstructure due to fast neutron irradiation
—effects of test, on microstructure changes in Type 316 SS following irradiation in sodium environment
—effect of deformation, on deuterium effusion in Type 304L SS
ZIRCALOY-2—radiation effects on stress-rupture at 300°C, in-pile
—fracture toughness of, contribution of deformation twinning to
ZIRCONIUM—radiation effects on microstructure of high pressure forms of, fast neutron
ZIRCONIUM A & S—Nb-Zr, radiation effects on stress-rupture at 300°C, in-pile
—corrosion of, research on in-reactor (L.C.L.)

24957 (BNWL-SA-2206) ULTRASONIC PROPERTIES MEASUREMENTS ON IRRADIATED MATERIALS. Hunter, D. O. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 19, 1968. 24p. (CONF-690305-4). Dep. CFSTI.

From Remote Handling and Examination in the Fast Reactor Field Meeting, Idaho Falls, Idaho.

Remote ultrasonic measurements have been made on irradiated steel. Results on specimens irradiated at temperatures less than 350°F indicate a fluence dependency. Results for some 304 specimens irradiated at 700 to 1000°F also indicate a fluence dependency but must be considered preliminary. Ultrasonic methods appear potentially useful in assessing the nature of radiation damage and recovery in steel specimens. (auth)

24958 (GEMP-1008, pp 51-113) RADIATION EFFECTS ON FAST REACTOR CLADDING AND STRUCTURAL MATERIALS. Moteff, J.; Kingsbury, F. D.; Smith, J. P. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.).

Creep-rupture tests of Incoloy 800 and Hastelloy X irradiated in the EBR-II indicate an effect of test temperature and/or stress level. At a test temperature of 540°C, the minimum creep rate is higher than that of control specimens; at temperatures of 650°C and above, the minimum creep rate is reduced by irradiation. Transmission electron microscopy studies of neutron-irradiated (5×10^{19} n/cm^2, $E_n \geq 1$ MeV) single-crystal vanadium revealed duplex cylindrical damage shells, ascribed to transmutation reactions, surrounding precipitate particles identified as tetragonal V_3B_2. The effects of annealing on the damage shells were studied at 330 to 1400°C. Transmission electron microscopy examinations of Mo irradiated (1.3×10^{20} n/cm^2, $E_n \geq 1$ MeV) at 1000°C were conducted. A study of the effect of irradiation on grain boundary sliding at 750°C was initiated on 316 stainless steel of two grain sizes. Hot-microhardness data were determined for single-crystal {100} Mo specimens in irradiated and unirradiated conditions. This single-crystal Mo did not show full recovery at 1100°C as noted in polycrystalline Mo. The results of an isochronal resistivity study of neutron-irradiated A-286 doped with two different boron contents (10 and 100 ppM by weight) are given. Dosimetry equations were developed. (J.C.W.)

24959 (GEMP-1008, pp 209-27) ADVANCED PRESSURE VESSEL MATERIALS. Robertshaw, F. C.; Stephan, H. R. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.).

The influence of pile ambient temperature irradiation on the Charpy V-notch impact properties of 12Ni-5Cr-3Mo, PH13-8Mo, and Inconel alloy 718 was determined. The ductile brittle transition temperature (DBTT) was increased within acceptable limits for the 12Ni-5Cr-3Mo and PH13-8Mo alloys. The impact strength of Inconel alloy 718 was increased by irradiation. The 12Ni-5Cr-3Mo maraging steel, in the normal condition of heat treatment, was found to undergo significant additional hardening during long-term heating in the range 290 to 400°C. A number of weldments were prepared of several program alloys using new GE-NSP welding facilities and are being evaluated. (J.C.W.)

24960 (ORNL-4377, pp 55-96) INVESTIGATIONS OF IRRADIATED MATERIALS. (Oak Ridge National Lab., Tenn.).

Data resulting from preirradiation testing of 12-in.-thick plates of ASTM A533B steel are presented tabularly and graphically. Data are included on tensile properties, impact properties, and fracture. Initial data resulting from radiation testing of similar steel specimens are also included on impact properties, tensile properties, and fracture. (F.S.)

24961 (ORNL-4390, pp 121-47) MECHANICAL PROPERTIES RESEARCH AND LMFBR CLADDING AND STRUCTURAL MATERIALS DEVELOPMENT. Weir, J. R. Jr.; McCoy, H. E. Jr. (Oak Ridge National Lab., Tenn.).

The mechanical properties of types 316 and 316L stainless steel are affected by irradiation and by thermal aging. Thermal aging causes an increase in the minimum creep rate, and irradiation reduces the fracture strain. Fractured samples of types 316 and 316L stainless steel modified with about 0.2% Ti revealed that the fracture mode was transgranular in both materials before and after irradiation. Specimens of type 304 stainless steel and nickel 270 were irradiated in EBR-II to fluences of 1.4×10^{18} to 2.6×10^{19} neutrons/cm^2 (>1 Mev) between 370 and 524°C. Electron

microscope examination of several of the samples of type 304 stainless steel irradiated at various temperatures to a fluence of 2.6×10^{19} neutrons/cm^2 (>1 Mev) showed that defect clusters were present after irradiation at 384 and 467°C but not at 524°C. Samples of nickel 270 irradiated at the same conditions contained voids at 384 to 524°C. The fracture ductility at 650°C of a heat of Incoloy 800 containing 0.1% Ti and 0.12% C was reduced by aging at 500°C after solution annealing at 1150°C. This aging resulted in lower fracture strains in the unirradiated and irradiated conditions. This embrittlement could be circumvented by annealing for 100 hr at 800°C after the 1150°C anneal, reducing the temperature of the solution anneal, and reducing the carbon content. Electron microscopy showed that the precipitate concentration and morphology vary with concentration of Ti and C. Two heats of Hastelloy N modified with 0.5% Ti and 0.5% Hf have been exposed to the molten-fluoride-salt environment of the Molten Salt Reactor Experiment core for 9789 hr at 650°C receiving thermal fluence of 5.3×10^{20} neutrons/cm^2. The postirradiation mechanical properties were measured and found to be much better than those for standard Hastelloy N under similar conditions. Postirradiation test results on samples irradiated at higher temperatures indicate that the Hastelloy N modified with Ti has very poor properties after irradiation at temperatures above 650°C. It was found that vacuum-melted standard Hastelloy N was susceptible to this effect of irradiation temperature. Several alloys containing strong carbide formers such as Hf and Nb were not influenced by irradiation temperature. Aging studies on the unirradiated titanium-modified alloy have been extended to aging times of 3000 hr at 650 and 760°C. Although the tensile and creep properties are responsive to heat treatment, the variations are too small to account for the temperature effect noted in irradiated samples. (auth)

24962 (ORNL-4390, pp 148-56) RADIATION EFFECTS IN ALLOYS AND STRUCTURAL MATERIALS. Wechsler, M. S. (Oak Ridge National Lab., Tenn.).

The tensile and notch-impact properties of neutron-irradiated samples from a 12-in.-thick plate of ASTM A 533-B Class 1 steel have been measured as a function of irradiation temperature and depth in the plate. Based on a normalization of the results to a fluence of 9×10^{18} neutrons/cm^2 (>1 Mev), smaller increases in yield stress were observed for samples taken from regions closer to the plate surface, but a similar conclusion could not be reached for the increases in ductile-to-brittle transition temperature because of the inherent scatter in the notch-impact test data. Notch-impact tests were conducted on weld metal from a full-thickness submerged-arc weld in a portion of a 12-in.-thick plate of ASTM A 533-B steel. No significant variation in properties was observed as a function of distance from the surface. The effect of low-temperature irradiation and postirradiation annealing has been investigated on tensile samples of vacuum-melted iron containing less than 2 ppM N by weight and samples doped with 20 and 300 ppM N by weight. The results indicate that radiation hardening and radiation-anneal hardening increase with increasing nitrogen concentration, which is interpreted in terms of the trapping of N at defect clusters produced by radiation. (auth)

24963 (RT/MET-(68)4) BEHAVIOR OF FISSION PRODUCTS WITHIN THE FUEL. A Seminar held by R. S. Nelson at C.S.N., Casaccia, Segre, G. J. (ed.) (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 24p. (In Italian). Dep.

The seminar held by R. S. Nelson (UKAEA) at the Casaccia Center on the behavior of fission products in reactor fuels such as U, UC, and UO_2 is reported. (F.S.)

24964 (SRARI-P-28) IRRADIATION DIFFUSION FACTORS ESTIMATE. Raetskii, V. M.; Pokrovskii, A. S. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1968. 14p. (In Russian). Dep.

Expressions were found for radioinduced diffusion capacities for U and Ni as a function of neutron flux, the mean discharge distance, and temperature at vacancy concentration less than 10^{-5}. At low temperature the radiation induced vacancies determine the diffusion mobility. The direction of the vacancy flux may influence the distribution of alloying elements and gas atoms in irradiated materials. (R.V.J.)

24965 (ZJE-55) IRRADIATION EFFECTS IN REACTOR PRESSURE VESSEL STEELS AND ELECTROSLAG WELDING JOINTS. Preliminary Report. Brumovsky, Milan (Skoda [Works], Pilsen (Czechoslovakia). Nuclear Power Plant Div.). June 1969. 22p. Dep.

Information about changes of basic mechanical properties of pressure vessel steels, caused by neutron irradiation is presented on materials such as steel ČSN 13030 (Ni, Al + Ti) and its electroslag welds, steel 13030 (MnNiMoNb) – type A 302 B steel – and its electroslag weld, and 1.5 Ni, 0.5 Cr, 0.5 Mo type steel, developed for reactor pressure vessels. (auth)

24966 INELASTIC INTERACTIONS OF SLOW ELECTRONS WITH ADSORBED PARTICLES: DEPENDENCE OF THE INTERACTION CROSS SECTIONS ON TEMPERATURE. Menzel, Dietrich (Technische Hochschule, Darmstadt, Ger.). Surface Sci., 14: 340-50(Apr. 1969).

The mechanism of the inelastic interaction of slow electrons with adsorbed particles, which has been proposed earlier, leads to the conclusion that the interaction cross sections should increase with temperature in regions where vibrational excitation of the surface bond becomes noticeable. Using a mass spectrometer capable of detecting both desorbing ions and neutrals, this effect has been verified for the electron-induced desorption of O^+ ions from strongly bound oxygen on tungsten. A temperature influence was also found for the neutral desorption of CO from carbon monoxide on tungsten in a certain temperature range. Several mechanisms, which could explain these results, are discussed. It seems probable that the mechanism proposed before indeed operates, so that the vibrational structure of the surface bond determines the temperature dependence of the desorption cross section. (auth)

24967 IRRADIATION EFFECTS IN NUCLEAR FUELS. An AEC Monograph. Robertson, J. A. L. Monograph Series on Nuclear Science and Technology. New York, Gordon and Breach, Science Publishers, Inc., 1969. 318p. $13.00. (TID-25017).

The requirements of nuclear fuels, mechanisms of irradiation damage, and experimental measurements are discussed. Irradiation behavior, phase studies, effects of alloying additions, corrosion behavior, and crystal and metallurgical structures are summarized for plutonium and uranium alloys. Properties, phase diagrams, and phase studies are discussed for oxides and mixed oxides of reactor fuels. Carbide fuels and other fissionable compounds are discussed. Irradiation effects on dilute and dispersion fuels are considered. (J.C.W.)

24968 EVIDENCE FOR ELECTRON-HOLE RECOMBINATION MECHANISM OF DEFECT PRODUCTION IN KCl AND NaCl AT 20°K. Martel, P.; Hallett, A. C. Hollis (Univ. of Toronto). Phys. Rev., 178: 1437-9(Feb. 15, 1969).

Measurements of the x-ray-induced expansion of KCl and NaCl have been carried out with a capacitive dilatometer at temperatures near 20°K. The expansion of KCl was found to be more than an order of magnitude greater than that of NaCl. Greater probability of nonradiative electron-hole recombination in KCl is suggested as the principal cause of the disparity. (auth)

24969 PRODUCTION AND STAGE-I RECOVERY OF LENGTH CHANGE IN ELECTRON IRRADIATED COPPER AND ALUMINUM. Hanada, Reimon. Evanston, Ill., Northwestern Univ., 1968. 120p.

Thesis.

Sensitive measurements of length change were made in electron irradiated copper and aluminum at liquid helium temperature. An expansion of $(\Delta l/l = 1.8 \pm 0.2) \times 10^{-23}$/e/cm^2 was found in the case of pure copper for 2.2 MeV electron. The specimen was found to bend linearly with electron doses. The magnitude of the bending was found to be 10^{-22} radians/e/cm^2. The direction of the bending is such that the rear part of the specimen is lengthening at higher rate than the front part. The result was interpreted in terms of Yang's correction of electron straggling in materials. Subsequent pulse annealing schedule showed the existence of sub-structure peaks in stage I temperature range. Three substage peaks, of which temperature positions are the same with those of I_B, I_C and I_D observed in resistivity recovery, were found in the present length change measurement. An anomalous positive recovery was found in the temperature range where I_A and I_E are present in resistivity measurements. Percentage of recovery in each substage was found to be almost the same with resistivity measurement results. The physical significance of the annealing results is that either resistivity and volume change due to a Frenkel pair do not depend on the separation distance between a vacancy and an interstitial or they depend on the distance in the same manner. (Disser. Abstr.)

24970 PHYSICAL FACTORS OF IONIC BOMBARDMENT AND ITS APPLICATIONS TO METALLOGRAPHY. Frade, Gilbert (Ecole National Superieure des Mines, Paris). Metaux (Corros.-Ind.), 43: 375-94(Nov. 1968). (In French).

The known physical factors which affect the ionic bombardment of metals are described. These factors include the pulverization yield, pulverization yield in the case of monocrystals, the ejected particles, and the penetration of ions into the target. The applications described are the ionic attack, ionic thinning, and ionic microprobes. (J.S.R.)

24971 EJECTION OF URANIUM BY FISSION FRAGMENTS: EVIDENCE OF CLUSTERS AND KNOCK-ONS. Verghese, K.;

Piascik, R. S. (North Carolina State Univ., Raleigh). J. Appl. Phys., 40: 1976-7(Mar. 15, 1969).

An experiment was conducted which gives evidence for the ejection of atom clusters as well as single atoms. A fully enriched U foil was optimally spaced from two Al collector foils on either side and irradiated in a subcadmium neutron flux. The distribution of U collected on the Al foils was studied by the following technique: The foils were contacted with glass slides, which were then irradiated in a neutron flux. The resulting fission fragment tracks in the slides were examined under a metallographic microscope after etching the slides. A uniform distribution of pits was observed, with scattered clusters of pits. (D.L.C.)

24972 ON THE CHARACTERISTICS OF 2.25 Cr–1 Mo QUENCHED AND TEMPERED STEEL (ASTM A542) AFTER HEAT TREATMENT. Sakai, Toshikazu; Kakimoto, Eitaro. Koatsuryoku, 6: 1443-9(Nov. 1968). (In Japanese).

The effects of Ni addition to improve notch toughness against the irradiation embrittlement and the conditions for heat treatment of A542 steel were studied. The optimum conditions for heat treatment were determined. The steel plate of 150 mm thickness which satisfied the ASTM A542 standard was obtained. Its notch toughness was comparatively low in the quenched and tempered state but was improved by stress-relief annealing. The addition of small amounts of Ni had little effect on the properties. The considerable decline of impact value was found in the central part. (NSA of Japan)

Ceramics and Cermets

Refer also to abstracts 24379, 24784, 24787, and 25026.

24973 (ORNL–4390, pp 3-33) DEVELOPMENT OF FAST-REACTOR OXIDE FUELS. Patriarca, P.; Lotts, A. L. (Oak Ridge National Lab., Tenn.).

Five Sphere-Pac $(U_{0.8}Pu_{0.2})O_2$ capsules for irradiation in EBR-II were fabricated. The accuracy and precision of the NITROX analysis for O in $(U,Pu)O_2$ have been defined. Irradiation of 2 ETR uninstrumented capsules containing Sphere-Pac $(U,Pu)O_2$ continues. Alpha autoradiographs were obtained of the other ETR capsules. Analysis of the temperature monitoring of the first instrumented capsule of Sphere-Pac fuels has been made. Hazards analysis of the transient test capsules to be conducted in TREAT is continuing and the hazards analysis for the Sphere-Pac test rods to be tested in the EBR-II was initiated. (J.C.W.)

24974 METAL HYDRIDES. Mueller, William M.; Blackledge, James P.; Libowitz, George G. (eds.). New York, Academic Press, Inc., 1968. 801p. $22.00. (TID–25030).

The bonding nature, chemistry, mechanical and physical properties, and thermodynamics of the metal hydrides are presented in the text with emphasis on nuclear applications. Chapters are devoted to actinide, hafnium, rare-earth, saline, scandium, titanium, yttrium, and zirconium hydrides. The covalent hydrides and hydrides of the Groups V to VIII transition metals are discussed. Fabrication processes are described. (J.C.W.)

Corrosion and Erosion

Refer also to abstract 25014.

24975 (BARC–378) STUDIES IN THE CORROSION OF ALUMINIUM BASE ALLOYS IN WATER AT VARIOUS pH VALUES. PART II. CORROSION OF DISPERSION HARDENED ALUMINIUM CONTAINING ALUMINA AND ALUMINIUM BASE MANGANESE, NICKEL, AND IRON ALLOYS. Shibad, P. P.; Elayathu, N. S. D.; Balachandra, J. (Bhabha Atomic Research Centre, Bombay (India)). 1968. 9p. Dep.

The effects of pH at 5, 6.5, and 8 on corrosion by water of dispersion hardened aluminum containing 4, 5, and 7% Al_2O_3 at 30, 85, and 100°C were investigated using weight loss and electrochemical methods. Alloys containing Al–1% Mn–0.7% Fe and Al–1% Ni–0.7% Fe were investigated under the same conditions. The corrosion rates of the dispersion hardened aluminum containing 4, 5, and 7% Al_2O_3 are in general higher than those of Al–1% Mn–0.7% Fe and Al–1% Ni–0.7% Fe alloys. While the corrosion process control in water of pH 8 at 30°C is essentially anodic for dispersion hardened aluminum specimens, that for Al–1% Mn–0.7% Fe and Al–1% Ni–0.7% Fe alloys is cathodic. The results obtained have been compared with those of aluminum-base silicon, nickel, magnesium, and A11S alloys. (auth)

24976 ON LOW-TEMPERATURE OXIDATION OF WC–Co COMPOSITIONS. Babich, M. M.; Lisovskii, A. F.; Lisovskaya, N. B. Porosh. Met., Akad. Nauk Ukr. SSR, No. 3, 96-100(Mar. 1969). (In Russian).

Low-temperature oxidation of WC–Co compositions is discussed. The influence of preliminary calcination of the compositions on their oxidizability is determined. (auth)

24977 OXIDATION AND GAS RELEASE BEHAVIOR OF UC, U(C,N), AND UN AT HIGH TEMPERATURE. Osawa, Yasutake (Mitsubishi Atomic Power Industries, Inc., Omiya, Japan). J. Nucl. Sci. Technol. (Tokyo), 6: 182-93(Apr. 1969).

The oxidizing behavior of UC, UN, and U(C,N) was studied at 800 ~ 1800°C in vacuum. The samples contained added oxygen in excess amounts. The oxidation in vacuum of UC and U(C,N) was found to proceed above 1200°C by stepwise reactions from one temperature interval to the next, the process differing however according to the chemical state of the oxygen present in the samples. In the temperature range below 1200°C, the UC and U(C,N) samples reacted violently with the free oxygen present in dissolved state, to form UO_2. Between 1200 and 1400°C the UO_2 thus produced reacted with the UC or U(C,N), forming solid solutions of U(C,O) and U(C,N,O), respectively: above 1600°C, these solid solutions gradually decomposed back into UC and U(C,N), and U. In all stages of oxidation, large amounts of CO— and N_2 in the case of U(C,N)— evolved from the samples as reaction products. In the case of UN, no reaction was observed below 1200°C, and only oxidized above that temperature to form UO_2 and N_2 by the action of the dissolved oxygen present. Results indicate that in the case of UC and U(C,N), the quantity of gases evolving from the oxidation is dictated by the total amount of oxygen contained in the samples, while that from UN is dependent on the amount of molecular oxygen alone. (auth)

Preparation and Fabrication

Refer also to abstracts 24347, 24352, 24369, 24410, 24811, 24814, 24821, 24825, 24830, 24872, 25001, and 26128.

24978 (BAW–3714-9) GEL-ADDITION PROCESS CHEMICAL STUDIES. Quarterly Progress Report No. 9, August–October 1968. Dewell, E. H. (comp.) (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). Jan. 1969. Contracts AT(30-1)-3714; 859-3100. 35p. Dep. CFSTI.

The development of the sol-gel process and related processes for preparing $(U,Pu)O_2$ fast reactor fuels was continued. Preparation of $(U\text{-}20Pu)O_2$ sol-gel spherical fuel in two size ranges for thermal reactor testing is complete. Two uranium enrichments, natural UO_2 and 20% enriched $^{235}UO_2$ were used to obtain material that will give two different in-pile heat rates at the same elemental compositions. The first irradiation capsule test is complete. The heat rate was 16.7 kW/ft, and the capsule received 9.3 EFPD. The capsule is the first of a series designed to show differences in restructuring kinetics between pellets and vibratory compacted spheres and shards. Equipment was installed for measuring particle crush strengths, water vapor contents, and oxygen-to-metal ratios in fuels. UO_2 gel and oxide spheres were examined on the B and W scanning electron microscope. (auth)

24979 (ORNL–TM–2518) PREPARATION OF IRON–THORIA AND IRON–ALUMINA CERMETS BY A SOL–GEL METHOD. Smith, F. J.; Krohn, N. A. (Oak Ridge National Lab., Tenn.). Feb. 25, 1969. 15p. Dep. CFSTI.

Iron–thoria and iron–alumina cermets were prepared by mixing oxide hydrosols of the components, gelling them, and reducing the iron oxide with hydrogen. After compaction by usual metallurgical techniques, thermal conductivity and hardness were measured. Although several compositions failed to give coherent compacts, it is concluded that this is a feasible method of preparing cermets of dispersion hardened metals. (auth)

24980 IRIDIUM COATED GRAPHITE ARTICLES. (to Union Carbide Corp.). British Patent 1,149,625. Apr. 23, 1969. Priority date Sept. 14, 1965, United States.

Iridium coated graphite structural materials which exhibit superior mechanical and physical properties at high temperatures are described. The pore-free iridium coating consists of an inner layer adjacent to the graphite which is formed of sintered finely divided iridium particles, an intermediate layer of vapor plated Ir and an outer layer of electroplated Ir. The coating is free of voids, resistant to thermal shock and strongly adherent to the graphite. (F.S.)

24981 METAL OXIDES. Hamling, Bernard Henry (to Union Carbide Corp.). British Patent 1,144,033. Mar. 5, 1969. Filed Feb. 24, 1967.

A process for production of metal oxide fibers, textiles and shapes is described in which preformed polymeric material may be impregnated with carbides or oxides of metals such as transi-

tion metals, rare earths, actinides, alkaline earth metals, aluminum, tin, and lead. The mass is heated high enough to carbonize and oxidize the polymeric material. The process makes possible new kinds of materials not feasible by other processes. (J.R.D.)

24982 PROCESS FOR MANUFACTURING SINTERED PELLETS OF NUCLEAR FUEL. Masselot, Yves (to Commissariat a l'Energie Atomique). British Patent 1,148,478. Apr. 10, 1969. Priority date Feb. 13, 1967, France.

A method is described for manufacture of sintered pellets of uranium dioxide, plutonium dioxide, thorium dioxide, or mixtures of these for use as fuel. The process consists of grinding the fuel into powder and adding 1 to 7% by wt of an organic salt as sintering inhibitor. The mixture is cold pressed into bodies which are broken into granules and coated by the inhibitor. The coated granules are cold pressed into pellets which are sintered in a reducing atmosphere at ≥1500°C. (F.S.)

24983 SLIP CASTING OF ZrC–W COMPOSITION. Dobrovol'skii, A. G. (Inst. of Problems in Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR, No. 2, 94-9(Feb. 1969). (In Russian).

Processes of slip casting a powder mixture at 70% ZrC + 30% W and sintering the blanks of this composition were investigated. An optimum composition was selected for obtaining stable slips, the blanks of which were cast without exfoliating the powders by height, without cracks, and with uniformly thick walls. The optimum composition slip involved the powder mixture 70% ZrC + 30% W, obtained by means of the joint grinding on vibromill, and 14% of 2% solution of carboxymethyl cellulose. (auth)

24984 ELECTRICALLY CONDUCTIVE CERAMIC MATERIAL. Anthony, Anne-Marie; Yerouchalmi, David (to Commissariat a l'Energie Atomique). British Patent 1,149,224. Apr. 16, 1969. Priority date Mar. 21, 1966, France.

An electrically conductive ceramic material which is to be used in the fabrication of electrodes for magnetohydrodynamic conversion ducts is described. The electrodes must have good pyroscopic resistance and high resistance to oxidation, chemical corrosion, erosion and physicochemical stresses. A suitable material for the fabrication of the electrodes was prepared from a mixture of 40 mole % monoclinic zirconia, 60 mole % of strontium zirconate or calcium zirconate, and 1% (based on the combined weights of the zirconia and the zirconate) of a refractory material. The refractory material was nickel, chromium, or titanium. Three methods for the preparation of the ceramic material from the starting materials are described. (G.M.C.)

24985 TECHNOLOGY OF NUCLEAR FUEL MATERIAL AND FUEL ELEMENTS: PRESENT STATE IN GERMANY. Ortmayer, R. M. (Nuklear-Chemie und Metallurgie, Wolfgang, Ger.). VDI (Ver. Deut. Ing.) Z., 111: 175-8(Feb. 1969). (In German).

The status of nuclear fuel material and fuel element technology in West Germany is described including methods used for producing and processing uranium dioxide and for fabricating and testing Zircaloy or steel-clad fuel elements. (L.C.L.)

24986 PREPARATION OF CUBIC ZrO_2 UNDER HYDROTHERMAL CONDITIONS. Chukhlantsev, V. G.; Galkin, Yu. M. (Ural Polytechnic Inst., Sverdlovsk, USSR). Zh. Neorg. Khim., 14: 311-14(Feb. 1969). (In Russian).

Chemical and roentgenographic studies were made on the products from the hydrothermal treatment of zirconium dioxide and hydroxide by calcium or magnesium hydroxides at 250 to 320°C. The results show that zirconium hydroxide and calcium hydroxide react to form a solid solution of CaO in ZrO_2 with cubic modification. No other reactions were observed. (tr-auth)

24987 SINTERED MATERIALS OF ZIRCONIA. I. GRAIN GROWTH AND PHASE TRANSITION OF ZrO_2. Yamauchi, S. Nagoya Kogyo Gijutsu Shikensho Hokoku, 17: No. 1-2, 21(1968). (In Japanese).

The grain growth and phase transition of ZrO_2 during the heat treatment of $ZrOCl_2 \cdot 8H_2O$ and $Zr(OH)_4$ were studied by an electron microscope, a thermo-balance, and an x-ray diffractometer. The particle size of the products from $ZrOCl_2 \cdot 8H_2O$ treated for 15 min at various temperatures was <0.04 μm at 400°C, with negligible growth up to 1000°, and 0.1 to 1 μm at 1200°C. It becomes 1 ~ 2 μm by heating for 90 min at 1200°. From $Zr(OH)_4$ heated for 15 min, it was <0.03 μm up to 700°C, about 0.1 μm at 1000° and 0.3 ~ 1 μm at 1,200° respectively. With $ZrOCl_2 \cdot 8H_2O$ an amorphous phase was observed between 80 and 350°, and a tetragonal phase between 400 and 450°; and for $Zr(OH)_4$ an amorphous phase was observed at a lower temperature than 350°, and a tetragonal phase between 400 and 1050°. The temperature range of the existence of the tetragonal phase of the low-temperature type varied with drying methods of the starting materials. It was thought that the range was concerned with the particle size of the dried materials. (Brit. Ceram. Abstr.)

Properties Evaluations

Refer also to abstracts 24808, 24838, 24869, 24884, 24885, 24897, 24916, 24932, 24979, 24980, 25014, 26061, 26127 and 26128.

24988 (CEA-CONF-1248) THERMAL CONDUCTIVITY OF MIXED URANIUM AND PLUTONIUM CARBIDES, NITRIDES, AND CARBONITRIDES. Van Craeynest, Jean Claude; Weilbacher, Jean Claude; Salbreux, Jean Claude (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires). [1961]. 11p. (CONF-681009-4). Dep.

From 8th Annual Conference of Thermal Conductivity, LaFayette, Ind.

The thermal diffusivity of mixed uranium and plutonium carbides, nitrides, and carbonitrides with a C/N ratios of 20/80, 35/65, 50/50, 65/35, and 85/15 and Pu/U ratio of 15% have been measured. Two thermal diffusivity methods have been used at 50 to 2000°C; the Angstroëm's method at 100 and 900°C and the Cowan's method at >1000°C. At every temperature the thermal diffusivity of the carbonitrides is intermediate between the MC and MN values. The thermal diffusivity, expressed as a function of carbon percent shows a maximum for (U,Pu)CN 35/65 and a minimum for (U,Pu)CN 65/35. This anomaly is more important at 100 than at 1500°C. In all cases the thermal conductivity (λ) has been calculated by the relation: $\lambda = \alpha . C_p . d$ where C_p is the specific heat and d the theoretical density. (auth)

24989 (GA-9239) RESEARCH ON GRAPHITE. Quarterly Progress Report for the Period Ending February 14, 1969. Bokros, J. C.; Engle, G. B.; Price, R. J. (Gulf General Atomic, Inc., San Diego, Calif.). Feb. 19, 1969. Contract AT(04-3)-167. 29p. Dep. CFSTI.

Grinding experiments were conducted on various graphites to determine the extent of pore removal. Compacts prepared from a petroleum-asphalt coke containing aluminum, titanium, or a combination of the two were heated for longer periods at 2100 or 2300°C. The specimens containing Al continued to convert to graphite, while the Ti-doped materials showed only traces of graphitic structure. Graphite compacts prepared with needle-coke particles and various amounts of binder coke have been irradiated at 1225 to 1250°C. A series of anisotropic and near-isotropic graphites were irradiated at 1000 to 1250°C. Samples of highly oriented, single phase-carbons and graphites are being irradiated to determine the radiation effects. Samples of hot-worked graphite, as-deposited massive pyrocarbon, and annealed massive pyrocarbon irradiated at 750 to 800°C and at 1250 to 1290°C have been examined and results given. The annealing studies of irradiated pyrolytic carbon structures have been completed. Hardness measurements are underway. Irradiation-induced dimensional changes in a variety of carbonaceous materials have been measured at 1250°C. (J.C.W.)

24990 (JAERI-1174) OXIDATIVE PULVERIZATION OF UO_2 PELLETS. Iwasaki, Matae; Sakurai, Tsutomu; Ishikawa, Niro; Kobayashi, Yasuko (Japan Atomic Energy Research Inst., Tokyo). Mar. 1969. 9p. Dep.

The relation between the condition of the oxidative pulverization of UO_2 pellet in air and the properties of the resulting powder, U_3O_8, was investigated. The pellets, sintered in vacuum at 1450°C, were oxidized in air in a muffle furnace at temperatures between 400 and 800°C. The particle sizes distributed over a range was less than 10 microns for the powders produced by oxidation at 400 and 500°C, while above 600°C, the distribution tended to spread over a wider range exceeding 10 microns. The surface area of the produced powder decreased with an increase in oxidation temperature. The surface area of the produced powder decreased when the powder was heated at 700 or 800°C, with no change in the particle size distribution of the powder. (auth)

24991 (KFK-817) CONSIDERATIONS ON THE CREEP OF UO_2 UNDER NEUTRON RADIATION. Brucklacher, D.; Dienst, W.; Thuemmler, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). July 1968. 24p. (In German). (EUR-3975). Dep.

It is concluded from literature dealing with changes in structure and density of canned porous UO_2 under neutron irradiation that the creep rate of UO_2 below about 1,200°C will be considerably increased under irradiation. The corresponding creep rates for a tension of 2 kg/mm² were estimated and compared to the creep rate of unirradiated uranium. Considerations of the mechanism underlying the acceleration of creep under irradiation are based on the well-founded assumption that within the examined temperature range (≦ 1,300°C) the creep rate is primarily determined by

quasi-viscous flow caused by diffusion. The diffusion promoting influence of various lattice defects caused by irradiation is estimated quantitatively. The results show that the literature information on an increased creep rate following irradiation can only be fully explained with the help of thermal spikes which accompany the fission of uranium. Apart from that, the growing concentration of point defects may also have a considerable influence. From these considerations it can be concluded that under the operating conditions of fast power reactors the creep rate of UO_2 fuel under a pressure of 2 kg/mm^2 equals at least the linear swelling rate caused by solid and included gaseous fission products. Thus, the total fuel pore volume is available for swelling, if the fuel canning is able to resist the indicated pressure in the fuel. However, this is only applicable as long as the remaining pores are not stabilized through the fission-gas pressure prevailing in their interior. (auth)

24992 (ORNL-4390, pp 273-93) PHYSICAL AND MECHANICAL METALLURGY OF REFRACTORY ALLOYS. Patriarca, P. (Oak Ridge National Lab., Tenn.).

The hafnium-rich phase that precipitates from a rapidly quenched and aged alloy within the miscibility gap of the Nb–Hf system consists of very small, disk-shaped particles mutually perpendicular to each other; in slowly cooled and aged specimens the precipitates appear as coarse rosettes. The tensile strength of quenched and/or aged specimens of Nb–5% Hf ranges between 71 and 108 × 10^3 psi with a ductility range between 0.6 to 12.1%. Curves for calculated solubility limit and chemical spinodal decomposition, based on the free energy of mixing of regular solutions, are compared with similar curves corrected for interactions of second nearest neighbors and clustering. The solubility is less and the spinodal curves are wider than the regular solutions. Current measurements indicate that the solubility of N in W increases rather than decreases with temperature. The diffusivity, D, and solubility, S, obey the expressions $D = 1.29 \times 10^{-2} \exp(-42{,}300/RT)$ cm^2/sec and $S = 7.5 \times 10^{-2} \exp(-14{,}850/RT)$ torr · liter cm^{-3} torr$^{-\frac{1}{2}}$. The creep-rupture properties of SU-16 (Nb–11% W–3% Mo–2% Hf–0.08% C) were determined between 980 and 1205°C. The development of brazing filler metals for joining refractory metals, ceramics, and graphite has continued. The Ti–V–Cr alloy system is particularly attractive in that compositions have been developed within it that will join all combinations of these materials. Compositions containing 25 to 48% Cr are better for Al_2O_3, whereas 5 to 25% Cr alloys are better for graphite. All seem to be useful for joining Ta. A complex forced circulation loop of T-111 alloy was successfully welded. It involved about 80 tungsten-arc welds, most of which were of the multi-pass, full-penetration type. No unusual problems were encountered. (auth)

24993 (ORNL-TM-2494) THERMODYNAMIC APPLICATIONS TO $(U,Pu)O_{2\pm x}$ FUEL SYSTEMS. Spear, K. E.; Olsen, A. R.; Leitnaker, J. M. (Oak Ridge National Lab., Tenn.). Apr. 1969. Contract W-7405-eng-26. 19p. Dep. CFSTI.

Thermodynamic information was used to describe equilibrium chemical interactions of $(U,Pu)O_{2\pm x}$ fuels with cladding and bonding materials in a fast reactor environment. The model describes the limiting behavior of a fuel system. Previous data are reviewed. (auth)

24994 ON THE USABILITY OF UC IN CO_2-COOLED REACTORS. Peehs, M.; Stehle, H. (Zentrale Entwicklung und Forschung, Siemens AG, Erlangen, Ger.). Kerntechnik, 11: 9-17(Jan, 1969). (In German and English).

Problems arising with UC fuel rods are associated with the compatibility of the fuel with the jacket material and the damage resulting from jacket defect. The interaction of the fuel with austenitic jacket materials begins at about 600°C. Zr/Cu alloys exhibit a better compatibility, reaching to over 700°C. The progress of damage of defective rods depends mainly on the size and the location of the defect. The swelling pressure of reaction products leads to the formation of secondary cracks and accelerated reactions with steel rod jackets but not with zirconium jackets. (auth)

24995 METHOD FOR THE DIRECT DETERMINATION OF THE PRESSURES OF OXYGEN IN EQUILIBRIUM WITH OXIDES AT 600°C. Le Brusq, Henri; Oehlig, Jean-Jacques; Marion, Fernand (Laboratoire de Chimie Generale, Somme, France). Compt. Rend., Ser. C, 268: 1047-9(Mar. 17, 1969). (In French).

The determination of the pressures of oxygen at 600°C by the measurement of the electric resistance of Cr_2O_3 in a static system makes possible the delimiting of the ranges of the stability of the α, β, γ, and δ oxides of Mo. (tr-auth)

24996 PROCESS TO IMPROVE DUCTILITY OF "METAL-OXIDE" COMPOSITE MATERIALS OR DISPERSED PHASE ALLOYS, PARTICULARLY OF ALUMINIUM–ALUMINA COMPOSITE MATERIALS. Jehenson, Pierre-Simon; Bauwens, Jean (to EURATOM). British Patent 1,148,504. Apr. 16, 1969. Filed June 29, 1965.

Sintered Al–Al_2O_3, which is a composite of the dispersed phase alloy type, shows advantages as a fuel element canning material in certain types of nuclear reactors. As prepared, however, this material is limited in use to self-resistant rigid cans, since it lacks creep ductility. The process for producing material of improved ductility described comprises producing an ingot or billet from the composite material in powder or wire form, or from partially oxidized metal powder by metal spraying the powder or wire on to a base body, and then subjecting the billet to mechanical working in order to obtain the required final mechanical properties. The billet may be submitted to thermal degassing and oxide stabilisation in a vacuum furnace. Some test results are given. (UK)

24997 ELECTRON MICROSCOPE OBSERVATION OF FRACTURE SURFACES OF WC–Co CEMENTED CARBIDES. Hara, A.; Nishikawa, T.; Yazu, S. Sumitomo Denki, No. 99, 98-110 (Mar. 1969). (In Japanese).

The examination of fracture surfaces provides useful information concerning the mechanism of a fracture. An examination of the fracture mechanism of WC–Co cemented carbides by electron micrography is described. An investigation of variations in the microfractograph for a series of WC–Co cemented carbides under various fracture conditions was undertaken. (auth)

24998 FISSION-GAS BEHAVIOR IN FUELS. Carroll, R. M. Nucl. Safety, 10: 210-16(May-June 1969).

Papers on fission-gas behavior published between 1966 and early 1968 are reviewed. During this period, additional work was performed in the areas of: fundamental studies, models, and calculations of fission-gas behavior; experimental methods and calculations; and engineering studies, calculations, and models. It now seems firmly established that fission gas is trapped at imperfections in a fuel matrix and that irradiation can increase the trapping probability. (auth)

24999 MECHANICAL PROPERTIES OF CERAMIC MATERIALS. Davidge, R. W. (Atomic Energy Research Establishment, Harwell, Eng.). Contemp. Phys., 10: 105-24(Mar. 1969).

The strength and fracture behavior of ceramics are considered with particular reference to oxides. Ceramics fracture in a brittle manner and the strength of most materials are about two orders of magnitude less than the theoretical strength. Strength is discussed in terms of a modified Griffith equation, and the important variables are effective surface energy and initial crack size. Both these variables can be related to microstructural features. The effective surface energy is relatively insensitive to structure. The Griffith crack size is more dependent on structure, but the controlling factors are only partly understood. Further advances require more detailed information about the role of grain and phase boundaries and the relationship to Griffith cracks. (auth) (UK)

25000 VISCOSITY AND DENSITY IN MOLTEN BeF_2–LiF SOLUTIONS. Cantor, S.; Ward, W. T.; Moynihan, C. T. (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 50: 2874-9 (Apr. 1, 1969).

The viscosity of the molten salt system, BeF_2–LiF, was determined with a coaxial-cylinder viscometer. The concentration range studied was 36 to 99 mole % BeF_2, each composition being measured over a 200° temperature interval within over-all limits of 376 to 967°C. The viscosity isotherms exhibited an exponential decrease in viscosity with increasing LiF concentration; the decreases were attributed to the rupturing of fluoride bridges in the BeF_2 network structure. Each composition displayed Arrhenius behavior (E_η, energy of activation for viscous flow, was independent of temperature). E_η decreased with LiF concentration in a way that paralleled the decreases in the analogous systems, SiO_2–alkaline-earth oxide. Densities were measured between 50 and 100 mole % BeF_2. From these measurements and other density determinations in BeF_2–LiF, it was found that the molar volumes were additive. Volume expansivity, however, increased markedly with increasing LiF concentration. The decrease of E_η with LiF content in this system was correlated with an increase in volume expansivity; for the composition range 100 to 70 mole % BeF_2, E_η was linear with the reciprocal of expansivity. (auth)

25001 QUENCH-AGING OF NIOBIUM–HYDROGEN ALLOYS AT -196°C. Sasaki, Yasuo; Amano, Muneyuki (National Research Inst. for Metals, Tokyo). Trans. Jap. Inst. Metals, 10: 29-33(Jan. 1969).

A decrease in electrical resistivity of niobium–hydrogen

alloys is observed during the isothermal aging at –196°C. It is shown that the aging process is a reaction with the time exponent of ⅓ and the activation energy of 0.10 ± 0.02 eV. A change in flow stress is also observed with the aging of this temperature. These phenomena are not found in hydrogen-free niobium. It is suggested that the changes in resistivity and flow stress should be attributed to the hydride precipitation at –196°C. (auth)

25002 INVESTIGATION OF EXTERNAL FRICTION OF NIOBIUM AND TANTALUM CARBIDES AT HIGH TEMPERATURES IN A VACUUM. Samsonov, G. V.; Kovalchenko, M. S.; Tkachenko, Yu. G. (Inst. of Problems in Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR, No. 2, 49-56(Feb. 1969). (In Russian).

The temperature dependence of the external friction of pairs of similar samples from NbC and TaC at room temperature to 1800°C in vacuum at 10^{-5} mm of Hg was investigated. The minimum friction coefficient of niobium carbide was observed at 1200 and tantalum carbide at 1300°C. It is established that in static contact of the investigated materials under loading at high temperature the creeping processes take place, controlled by thermally activated dislocation slip. An energy of slip activation is equal to 1.3 eV for NbC and 1.4 eV for TaC. (auth)

25003 DEFORMATION OF Zr–N ALLOYS. Tyson, W. R.; Craig, G. B. Can. Met. Quart., 7: 119-26(July-Sept. 1968).

The effect of N_2 in interstitial solid solution on the tensile properties of close-packed hexagonal Zr polycrystals was measured. The results were analyzed with the aid of the theory of thermally activated deformation. Between 77 and 635°K, N_2 has a profound strengthening effect, increasing the tensile flow stress at 295°K by 45 kg/mm²/at. % N_2; activation volumes decrease with increasing effective stress to ~15 b^3 in an alloy containing 1 at. % N_2 and the activation enthalpy rises to 1.4 eV at zero effective stress. The results indicate that isolated N_2 atoms are effective barriers below 635°K. The resistance to deformation may be due to interference with atomic motions at the core of gliding dislocations. Above 635°K., strengthening is less marked; there is an athermal region up to about 750°K and, above this temperature, the flow stress drops rapidly as a yet-unidentified mechanism becomes operative. (Metals Abstr.)

25004 POROSITY DEPENDENCE OF ELASTIC MODULUS OF URANIUM NITRIDE. Honda, Toshio; Kikuchi, Takeo (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 6: 221-2(Apr. 1969).

Density and elastic modulus measurement methods are described and results are presented on the elastic modulus of UN as a function of volume fraction porosity at room temperature. The results indicate that the elastic modulus increases with decreasing specific surface area. (F.S.)

25005 PHYSICAL PROPERTIES OF GRAPHITE. Reynolds, W. N. Elsevier Materials Science Series. New York, American Elsevier Publishing Company, Inc., 1968. 202p. $11.00.

Information in the book is presented in chapters on structure, mechanical properties, thermal properties, electric and optical properties, surface and physico-chemical properties, point defects and high-flux neutron damage. (J.R.D.)

25006 INTERFACIAL COHESION. Greenough, A. P. London, Her Majesty's Stationery Office, 1968. 38p.

The forces existing at the interfaces between different materials when in contact are discussed. Both theoretical and experimental aspects are covered along with the current state of development and areas for future research. Interfaces are classified as the grain boundaries in a pure metal, in a solid solution alloy, between phases in a two-phase alloy, and between metal-ceramic interfaces. The inherent properties of interfaces are discussed including interfacial energy, surface energy, and grain boundary energy in solid and liquid solutions. The relationship between interfacial energy and cohesion is examined as is the stability of interfaces. Practical implications of the breakdown of interfacial cohesion are discussed for fiber reinforced materials (tensile, impact and fatigue properties of W-reinforced Cu, B-reinforced Mg and glass reinforced plastics), dispersion hardened materials (low- and high-temperature mechanical properties of SAP, dispersion hardened Cu and TD-nickel), dispersed-phase nuclear fuel elements (UO_2-stainless steel and UO_2-Al elements), metal ceramic seals, cermet cathodes, glass-resin composites and evaporated films. The role of breakdown of interfacial cohesion in the embrittlement by liquids is discussed for polycrystalline silver chloride. (Metals Abstr.)

25007 TEMPERATUROUSTOICHIVYE ZASHCHITNYE POKRYTIYA. Trudy III Seminara po Zharostoikim Pokrytiyam, Leningrad, 27–31 Maya 1966 g. (Heat-Resistant Protective Coatings. Proceedings of the 3rd Seminar on Heat-Resistant Coatings, Leningrad, May 27–31, 1966). Borisenko, A. I. (ed.). Leningrad, Izdatel'stvo Nauka, 1968. 355p. (CONF-660579).

Theoretical analysis of the heat resistance, diffusion, fusion of coating with metal, precipitation of metallic and carbide coatings, high-temperature test of inorganic heat resistant coatings, and simplified methods for determining the strength of ceramic coatings are discussed. Formation of gas phase coatings and properties of Zr, Nb, Ta, Mo, and W carbide coatings, and chromium diffusion, colorizing and vanadization on the fatigue and strength of steel of elevated temperatures are also covered. Discussions are included on problems of melted state coatings, carbide coating on graphite, coating by means of plasma, erosion-resistance coating of WC and WC with Co, vitrous-metallic coating on steel and stability and resistance of metal-ceramic coating to stripping. Microstructure of organic-silicate materials, low-temperature oxidation of high-melting point compounds, thermographic and thermogravimetric studies of organic silicate materials are also discussed. (R.V.J.)

25008 FRICTION AND WEAR OF GRAPHITE IN DRY HELIUM AT 25°, 400°, AND 800°C. Stansfield, O. M. (Gulf General Atomic Inc., San Diego, Calif.). Nucl. Appl., 6: 313-20(Apr. 1969).

Four high-strength, fine-grain commercial-graphite friction couples were rubbed with oscillating motion for a distance of 6,250 or 12,500 cm in dry helium (~2 ppM H_2O) at 25, 400, and 800°C. Loads of 2 or 8 kg were used to produce nominal contact pressures of between 4.2 and 35.0 kg/cm². The friction coefficient for all the materials was a complex function of sliding distance, temperature, and degree of outgassing prior to sliding. When the graphites were outgassed at 400°C, the friction during initial sliding (25 to 250 cm) at 25, 400, and 800°C first increased by factors of 1.1 to 4 and then decreased rapidly to values similar to that at the onset of sliding. The maximum friction transients of outgassed graphite were observed at 400°C, and minimums were observed at 800°C. The transient was not produced when outgassing and sliding were conducted at 25°C. The friction coefficient for most of the sliding distance varied between 0.35 and 0.40 at 25 and 400°C, while at 800°C the typical coefficient was 0.30. Wear properties of the graphites appeared similar. During sliding under equal loads, the wear at 25°C was about ten times greater than at 400 or 800°C. The wear rate apparently decreased rapidly with sliding distance. Wear factors ranging from 3×10^{-5} to 5×10^{-4} cm³/kg load were measured at 400 and 800°C for both 6,250 and 12,500 cm sliding distance. (auth)

25009 PLANAR HALL EFFECT IN PYROLYTIC GRAPHITE. Yasunaga, Hitoshi; Okuyama, Naoki; Takeya, Kenichi (Univ. of Electro-Communications, Tokyo). J. Phys. Soc. Jap., 26: 1062 (Apr. 1969).

Preliminary measurements of the planar Hall effect (Hall effect of second order in magnetic field) were made on pyrolytic graphite at room temperature. The transverse voltage in the y direction exhibits an angular dependence similar to that of the magnetoresistance, which varies as 1-cos 2θ. Displacing the probe in the x direction produces the expected sin 2θ component. The magnetoresistance-like component may be attributed to an inhomogeneity in the sample. (D.L.C.)

25010 CATION SELF-DIFFUSION IN POLYCRYSTALLINE Y_2O_3 AND Er_2O_3. Berard, M. F.; Wilder, D. R. (Ames Lab., Iowa). J. Amer. Ceram. Soc., 52: 85-8(Feb. 21, 1969).

A tracer sectioning technique was used to measure cation self-diffusion coefficients in fully dense polycrystalline Y_2O_3 and Er_2O_3 under oxidizing conditions. The results are described by the relations $D = 1.65 \times 10^{-2} \exp(-69{,}200/RT)$ cm²/s for Y_2O_3 (1400 to 1670°C), and $D = 1.48 \exp(-102{,}200/RT)$ cm²/s for Er_2O_3 (1400 to 1700°C). The greater activation energy for erbium diffusion in erbia may be partly attributable to a mass effect. (auth)

25011 SOME NEW PROBLEMS AND RESULTS IN THE FIELD OF BERYLLIA CERAMICS. Ryshkewitch, E. Keram. Z., 20: 350(1968). (In German).

An attempt to produce sintered BeO by heating the hydroxide with Be metal was unsuccessful. BeO films were deposited on substrates by thermal decomposition of organic Be salts. (Brit. Ceram. Abstr.)

25012 DISLOCATION–INTERSTITIAL INTERACTION IN THE NIOBIUM–NITROGEN SYSTEM. Dollins, Charles Curtis. Urbana, Ill., Univ. of Illinois, 1968. 89p.

Thesis.

The precipitation of nitrogen onto dislocations in deformed niobium has been measured using anelastic methods and transmission electron microscopy. The specimens, wires about 1 mm in diameter, were equilibrated with nitrogen at a high temperature and then quickly cooled to produce a homogeneous, supersaturated solid solution. After room temperature deformation, they were aged at temperatures between 300 and 500°C to precipitate the nitrogen onto the dislocations. The nitrogen left solid solution in time dependence given by the expression t^n as measured by the decay of the Snoek peak of nitrogen. This time dependence agrees with the laws established by Bullough and Newman for formation of continuous or discrete precipitates along dislocations. Transmission electron microscopy was used to deduce the character of the precipitates. The nature, location, size, and habit plane of the precipitates were determined as a function of time. This habit plane is {100}, the same as that of Nb_2N. Attention was given to the dislocation distribution and its effect on the kinetics of precipitation. The development and decay of the cold work peak were followed by internal friction measurements and were correlated with the nature of precipitates as seen by electron microscopy. This comparison showed that the cold work peak reached its maximum when the precipitate particles were about 800 Å in size, well after the formation of the initial atmosphere. (Disser. Abstr.)

Structure and Phase Studies

25013 (AECL-3222) EFFECT OF PRIMARY U_3Si_2 PARTICLE SIZE AND DISTRIBUTION ON THE PERITECTOID REACTION IN URANIUM–SILICON ALLOYS. Berthiaume, L. C.; Wyatt, B. S. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Dec. 1968. 24p. Dep. CFSTI. CAN $1.00.

The effect of the primary U_3Si_2 particle size on the transformation to U_3Si of as-cast U/Si alloys has been studied. The influence of the dispersion of fine U_3Si_2 particles in the eutectic matrix is also discussed. Samples of a U–4.0 wt % Si alloy were fabricated with particle sizes varying from 8 to 900 μm. It was found that only the samples having primary U_3Si_2 particles smaller than 30 μm could be fully transformed when heat treated at 800°C for 72 hours. The results suggest that uranium–silicon rods should be cast with as small a U_3Si_2 particle size as possible. One method of minimizing the particle size is to cool as quickly as possible from the melt during casting. (auth)

25014 (MLM-1589) A SUMMARY OF THE PHASE DIAGRAMS AND COMPATIBILITY OF PuO_2 WITH VARIOUS MATERIALS. Selle, J. E. (Mound Lab., Miamisburg, Ohio.). Apr. 21, 1969. Contract AT-33-1-GEN-53. 38p. Dep. CFSTI.

A compilation of the available information on the phase diagrams and compatibility of PuO_2 with various materials is presented. X-ray data are given when available, along with a complete list of references. (auth)

25015 ETA CARBIDES OF MOLYBDENUM–IRON, MOLYBDENUM–COBALT, AND MOLYBDENUM–NICKEL. Fraker, A. C. (National Bureau of Standards, Washington, D. C.); Stadelmaier, H. H. Trans. Met. Soc. AIME, 245: 847-50(Apr. 1969).

In the systems Mo–Fe–C, Mo–Co–C, and Mo–Ni–C the phase boundaries of the cubic η carbides were determined at 1000°C and the variation of the lattice parameter with composition was measured. In the system Mo–Fe–C a single ternary carbide, Mo_3Fe_3C, was observed. In Mo–Co–C and Mo–Ni–C two new η phases of the type $M_{12}C$ were found: Mo_6Co_6C and Mo_6Ni_6C. At 1000°C they coexist with the M_6C phases $Mo_{3-4}Co_{3-2}C$ and $Mo_{3-4}Ni_{3-2}C$, respectively. Mo_3Co_3C and Mo_4Co_2C are not separate phases but parts of a single M_6C phase region, and the same is true of Mo_3Ni_3C and Mo_4Ni_2C. (auth)

25016 INVESTIGATION OF STRUCTURE OF CERMET HARD ALLOYS WC–Co AND WC–TiC–Co BY MAGNETIC METHODS. Tumanov, V. I. (All-Union Scientific-Research Inst. of Hard Alloys, Moscow). Porosh. Met., Akad. Nauk Ukr. SSR, No. 3, 77-81(Mar. 1969). (In Russian).

The possibilities of correlating the magnetic properties (magnetic induction, coercive force) for the alloys WC–Co and WC–TiC–Co of different phase composition and with different content of cobalt are considered. The structure of high-cobalt hard alloys can be represented as occurring in a form of a cobalt matrix with isolated carbide grains incorporated in it. With a low content of the binding phase when the grains of the carbide component are coalesced into a conglomerate (or form a carbide frame) the cobalt matrix is isolated into separate parts which are not connected between themselves. The region of transition from one type of the structure to another in three-phase titanium alloys depends on the titanium carbide concentration. (auth)

25017 ON THE BINARY SYSTEMS V_2O_5–Gd_2O_3 AND V_2O_5–Er_2O_3. Brusset, Henry; Madaule-Aubry, Francoise; Blanck, Bernard; Deboichet, Annie (Ecole Centrale des Arts et Manufactures, Paris. Faculte des Sciences, Paris). Bull. Soc. Chim. Fr., No. 1, 15-16(Jan. 1969). (In French).

In a general study of mixed oxides involving a rare earth element, the binary systems V_2O_5–T_2O_3 (T is one of such elements) are examined. Data obtained are given here in the case of gadolinium and erbium compounds. (tr-auth)

25018 PHASE RELATIONS IN THE SYSTEM URANIUM–SULFUR–OXYGEN. Shalek, Peter Dean. Urbana, Ill., Univ. of Illinois, 1968. 129p.

Thesis.

Phase relations have been established in the uranium–sulfur–oxygen system, using a wedge melting point apparatus to obtain the high temperature data. Two new low temperature phases have been identified in the uranium–sulfur–oxygen system. They are UO_2 and U_3O_8 structural phases which retain sulfur. Uranium oxysulfide has a large solubility for UO_2 because of its layered structure, and its structure has a definite relationship to that of UO_2. The terminal UOS solid solution melts peritectically in the UOS–UO_2 pseudobinary system. Stoichiometric UOS forms a simple eutectic system with US and a eutectic-like system with U_2S_3, which melts peritectically in the US–U_3S_5 pseudobinary system. U_2S_3 has a very limited phase area. Uranium monosulfide has a small oxygen solubility at high temperatures and exists as a $U_{1-x}S$ phase in hyperstoichiometric compositions. US is not soluble in UO_2 and forms a simple eutectic system with this compound. Liquids in the US–UO_2 pseudobinary system behave as regular solutions. The US–UOS–U_2S_3 subsystem is described by the eutectic reaction, L = US + UOS + U_2S_3, at 1590°C. The US–UOS–UO_2 subsystem is described by the reaction, L + UO_2 = UOS + US, at 1730°C. Because of the peritectic-like nature of this reaction, nonequilibrium cooling is common, and crystallization occasionally proceeds into the adjoining US–UOS–U_2S_3 subsystem. Study of equilibrium relations in the U-S-O system is complicated by the tendency of UOS and U_2S_3 to compose, both in the solid state and from their solutions. In all cases, there is a net loss of sulfur. (Disser. Abstr.)

25019 THERMODYNAMICS OF RARE-EARTH–CARBON SYSTEMS. I. THE CERIUM–CARBON SYSTEM. Balducci, G.; Capalbi, A.; De Maria, G.; Guido, M. (Univ., Rome). J. Chem. Phys., 50: 1969-74(Mar. 1, 1969).

The gaseous phase in thermodynamic equilibrium with the condensed cerium–carbon system has been investigated by means of the combined Knudsen-cell–mass-spectrometric technique in the temperature range 1990 to 2300°K. In addition to cerium atoms, the gaseous carbide molecules CeC_2 and CeC_4 were identified and their partial pressures measured. A heat of formation for the solid cerium dicarbide was obtained. (auth)

Radiation Effects

Refer also to abstracts 24963 and 26128.

25020 (BMI-1859) PROGRESS ON HIGH-TEMPERATURE FUELS TECHNOLOGY DURING NOVEMBER 1968–JANUARY 1969. Quarterly Report, Task 6. Keller, Donald L.; Chubb, Walston (Battelle Memorial Inst., Columbus, Ohio). Feb. 1969. Contract W-7405-eng-92. 74p. Dep. CFSTI.

Measurements of the amount of gas retained in nuclear fuels after irradiations at temperatures from 1470 to 1700°C confirmed the belief that swelling at these temperatures is caused by gas retention. The measurements also support the theory that the phenomenon called saturation of swelling is caused by release of gas at the same rate as it is being generated. A sample of UN which showed saturation of swelling at a burnup near 0.8×10^{20} fissions per cm^3 contained less than 3 percent of its fission gas after a burnup of 2.4×10^{20} fissions per cm^3. A sample of UO_2 which showed saturation of swelling at a burnup near 1.0×10^{20} fissions per cm^3 contained 21 percent of its fission gas after a burnup of 1.9×10^{20} fissions per cm^3. A sample of UC which did not show saturation of swelling after a burnup of 2.0×10^{20} fissions per cm^3 contained 58 percent of its fission gas at this burnup. Uranium monocarbide exhibited 37 percent elongation in tension in creep tests at 1400°C, and its vapor pressure is two orders of magnitude lower than those of UN and UO_2. A number of UN specimens operating at temperatures between 1675 and 1910°C have shown a breakaway swelling behavior that has been associated previously with dissociation of the uranium to form free uranium metal. Gas release from activated UC has been explained in terms of a model that accounts for the changing rates of gas release during the early parts of the process, including the so-called burst and the later parabolic release. The solubility limit of fission gas in UC and the chemical diffusion rates of xenon in UC

have been obtained. The diffusion coefficients obtained at 1300 to 1700°C can be described by the equation: $D_{Xe} = 4.8 \times 10^{-2}$ exp (−70,000/RT). These diffusion coefficients are greater by about one order of magnitude than the self-diffusion coefficients for uranium in UC and greater by three or more orders of magnitude than those obtained by other investigators for the diffusion of fission gas in UC. A mechanism by which the mechanical properties of nuclear fuels may be degraded by the fission event is suggested. The supposition is that fission events anneal cold work in the thermal spike region, thereby preventing work hardening from contributing appreciably to the strength of nuclear fuels. A comparison of out-of-pile primary creep data for UC at 1300°C with in-pile creep data obtained from swelling data for UC at 1300°C shows that this mechanism provides a qualitatively correct explanation of the observations. (J.C.W.)

25021 (ORNL-4390, pp 58-71) FISSION-GAS RELEASE AND PHYSICAL PROPERTIES OF FUEL MATERIALS DURING IRRADIATION. Sisman, O. (Oak Ridge National Lab., Tenn.).

Data obtained in thermal diffusivity measurements of fuels during irradiation have been unsatisfactory because of too much scatter and unexplainably low values. Stored energy was released during the step changes in irradiation conditions and this unsuspected energy source caused the diffusivity to appear low. Pellets of $(U,Pu)O_2$ fuel made to Fast Flux Test Facility (FFTF) specifications released fission gas in a way that indicated the specimen as manufactured contained a network of tiny cracks. These cracks were partially healed by irradiation at 1100°C, but an attempt to increase the healing rate by using higher temperatures and fission rates resulted in extensive cracking of the specimen. Spheres of $(U,Pu)O_2$ are now being irradiated. Spheres of crystalline UO_2 broke because fission products concentrated at defects and generated enough stress to cause rupture. Post-irradiation metallography showed that the amount of breaking was as predicted by the amount of fission gas released during irradiation. (auth)

25022 (ORNL-4390, pp 113-14) BEHAVIOR OF REFRACTORY MATERIALS UNDER IRRADIATION. Keilholtz, G. W.; Moore, R. E.; Dyslin, D. A. (Oak Ridge National Lab., Tenn.).

Hot-pressed and slip-cast monocarbides of Ti, Zr, Ta, Nb, and W were irradiated to fast-neutron fluences up to 4 to 5×10^{21} neutrons/cm^2 at 1000 to 1100°C, and explosion-pressed carbides were irradiated to a fluence of about 2.5×10^{21} neutrons/cm^2. None of the specimens showed changes in microstructure or lattice size. The maintenance of structural integrity and the absence of major property changes during irradiation are very encouraging for the applicability of carbides in high-temperature nuclear devices designed for long-term operation. (auth)

25023 (ORNL-4390, pp 115-20) FAST-NEUTRON IRRADIATION EFFECTS ON ELECTRICAL INSULATORS. Keilholtz, G. W.; Dyslin, D. A.; Moore, R. E.; Robertson, H. E. (Oak Ridge National Lab., Tenn.).

Metallographic examinations showed that increasing the temperature at which large-grained (25 μm) alumina is irradiated causes an increased amount of damage through grain-boundary separation. A reversal of this trend begins only at temperatures of about 1000°C or above, presumably because of annealing in the reactor. Results were obtained from a short-term irradiation [0.4 to 3.1×10^{21} neutrons/cm^2, (>1 Mev)] of three commercial types of small-grained (<10 μm) alumina and one commercial type of large-grained alumina at various temperatures from 400 to 1230°C. About half the specimens of the two small-grained types of alumina contained the most impurities fractured during irradiation. Very little gross damage occurred to specimens of the highest purity small-grained type of alumina. In this irradiation, the impurity content appeared to be the predominant factor causing fracturing. The irradiation of an identical long-term assembly is continuing. (auth)

Plastics and Other Materials

Refer also to abstracts 24359, 24890, 25006, and 25025.

25024 CHANGES IN WOOD PROPERTIES CAUSED BY RADIATION. I. CHANGES OF PHYSICAL AND MECHANICAL PROPERTIES. Jokel, Jozef (Statny Drevarsky Vyskumny Ustav, Bratislava). Drev. Vysk., 1: 1-15(1967). (In Czech).

Spruce, oak, beech, and poplar wood was irradiated by high energy electrons (1.8 MeV) within the integral dose range of 5×10^3 to 5×10^8 rad. Measurements were made of the bending strength, toughness, hygroscopicity, and imbibition was determined of the irradiated wood. Results showed that: ionizing radiation did not have the same affect on the mechanical properties of various wood species; a significant destructive effect of radiation on the mechanical properties of wood was evident first at the dose as high as 5×10^6 rad, while the doses lower than 10^6 rad increased the bending strength and eventual toughness of the investigated hardwood species. Spruce wood was affected by doses as low as 10^4 rad; the absorption of radiation energy changed the affinity of wood to water in a gaseous and liquid phase. At the dose 5×10^8 the wood took up humidity at a lower rate, but its imbibition was higher. Spruce wood showed the highest imbibition; no post-radiation effect was observed on the irradiated wood; and at high doses of radiation, the irradiated wood changed its color tending to the development of brownish tones. (auth)

25025 ENGINEERING GLASS. Shand, Errol B. (Technical Consultant on Glass and Ceramics, Corning, N. Y.). Mod. Mater., Advan. Develop. Appl., 6: 247-317(1968).

The composition, manufacture, and properties of glass are described as a preface to engineering uses of glass. These uses include structural applications, vehicle glazing, piping, heating panels, lubricants, electric and electronic uses, and glass for science such as in linear particle absorbers, radiation absorbers, and bubble chamber windows. The differences between glass and other materials in common use and the different design and handling techniques required for engineering glass are emphasized. (L.C.L.)

25026 MODERN MATERIALS. ADVANCES IN DEVELOPMENT AND APPLICATIONS. VOLUME 6. Gonser, Bruce W. (ed.). New York, Academic Press Inc., 1968. 393p. $18.00.

Six articles on the preparation, properties, and uses of modern materials including wood-plastics, jewels, solid propellants, superconductors, glass, and beryllium are presented. Separate abstracts were prepared for four. The remaining two are not within the scope of NSA. (L.C.L.)

For abstracts of individual papers see: 24227, 24822, 25025, and 25241.

PHYSICS (GENERAL)

Astrophysics and Cosmology

25027 A DISCUSSION OF INFRARED ASTRONOMY, 1–2 MAY 1966. Phil. Trans. Roy. Soc. London, Ser. A, 264: 107-320(Apr. 24, 1969).

The following topics are considered: Mid-infrared spectroscopic observations of the Moon; temperature distribution of the Moon; problem of thermal conductivity equation in presence of radiative energy transfer; chemistry of Jupiter's upper atmosphere; infrared day and night airglow of the Earth's upper atmosphere; emission spectrum of night airglow from 2 to 4 μm; interferometric spectra of the Earth's airglow (1.2 to 1.6 μm); high-resolution spectra of the Sun; infrared solar spectrum as observed from balloons; submillimeter solar radiation at sea level; the solar continuum in the far-infrared and millimetre regions; near infrared photometry of late-type stars; infrared radiation associated with protostars; hydrogen molecules and the Hayashi effect; expected infrared spectra of gaseous nebulae; radio emission from high level transitions in hydrogen; extragalactic radio sources in the infrared; quasi-stellar objects; a far infrared sky survey; near infrared night sky background; infrared astronomy and cosmology; some problems and instrumental features of submillimetre astronomy; millimetre and submillimetre astronomy; submillimetre astronomy—results and prospects; large flux collectors for infrared astronomy; project to map the sky in the infrared from an ESRO satellite. (UK)

Cosmic Ray Exposure Ages

25028 STUDIES OF MATERIAL IN POLAR ICE. Fireman, E. L. Antarctic J. U. S., 3: 250-2(Nov.-Dec. 1968).

Isotope anomalies were sought in sediments of melted polar ice as evidence of extraterrestrial material deposition. If an extraterrestrial component of the material originated from small particles (less than 5 cm in dia) of chondritic composition, it would contain appreciable amounts of ^{26}Al and ^{39}Ar produced by action of solar flares and cosmic rays. Since some ^{26}Al is produced in the atmosphere, only an excess ^{26}Al over that expected from the atmosphere can be attributed to this extraterrestrial source. Another radioactive isotope, ^{10}Be, which is produced in the Earth's atmosphere by cosmic rays, gives a measure of the amount of ^{26}Al and ^{10}Be in the dissolved material and in the particulates. By combining the activities with the precipitation rate, which is known to be 30 cm^3 of water/cm^2/yr, the ^{26}Al and ^{10}Be production rates were calculated to be $(1.7 \pm 0.5) \times 10^{-4}$ and $(3.6 \pm 1.1) \times 10^{-2}$ atoms/sec/cm^2. The low ^{26}Al to ^{10}Be ratio is consistent with the production of these isotopes in the Earth's atmosphere. If the Ni and Co contents that were found to predominate indicated an influx rate of chondritic-type material of one million ton/yr, the low ^{26}Al content indicated that the extraterrestrial material arrived in the form of bodies that were greater than 5 cm in dia and that were shielded from solar flares. An upper limit for ^{39}Ar of 0.04 dpm was observed in a 15-g sample of material taken from the storage tanks. This limit corresponds to 2 dpm/kg. The low ^{39}Ar could be explained either by shielding of the extraterrestrial material or by dissolution of the component containing ^{39}Ar. (BBB)

Stars

Refer also to abstract 25509.

25029 ABSOLUTE EMISSION-LINE INTENSITIES IN PLANETARY NEBULAE. Vorontsov-Vel'yaminov, B. A.; Kostyakova, E. B.; Dokuchaeva, O. D.; Arkhipova, V. P. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 895-7(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 1128-31(Sept.-Oct. 1968).

Emission-line intensities (in ergs/cm^2 · sec) in the spectra of 27 planetary nebulae were determined from spectrograms taken with an objective prism. For most of the nebulae eight or nine lines in the spectral range 3700 to 6600 Å were measured. The procedure for reducing the material has been described previously. Absolute emission-line intensities were determined for the first time for eight of the nebulae. No line-intensity measurements have previously been reported for three of the nebulae. (auth)

25030 METHOD FOR COMPUTING ABSORPTION-LINE PROFILES. Kats, I. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Propagation, Novosibirsk, USSR). Sov. Astron. AJ (Engl. Transl.), 12: 844-51(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 1066-76(Sept.-Oct. 1968).

A discussion is given of the theoretical construction of absorption-line profiles in a magnetoactive medium for a constant ratio of the absorption coefficient at the line center to the absorption coefficient in the continuum. The scattering within the line is assumed coherent. The radiative-transfer equations are reduced to a system of integral equations of the Wiener–Hopf type. The solution of this system is shown to be symmetric about the plane containing the vector normal to the plane boundary of the atmosphere and the magnetic-field vector. The solution does not decrease with increasing optical depth, provided that the source function does not decrease. In order to apply the integral equations that are obtained, a new numerical method of solution is developed, generalizing the standard method of Krylov and Bogolyubov. Computations by the two methods give relative errors of 0.3% and 4% respectively, for the parameters adopted. An absorption-line profile is computed and compared with the corresponding profile obtained by Rachkovskii using Chandrasekhar's method. The profiles are qualitatively similar; the greatest departure from Rachkovskii's results occurs at the line center. Several symmetry relations and limiting formulas needed for understanding the main text are derived in an Appendix. The opportunity is taken to correct an error that has appeared in the literature concerning the Voigt representation of the line absorption coefficient. (auth)

25031 DETERMINATION OF THE LIMB-DARKENING COEFFICIENT AND ORBITAL ELEMENTS OF ECLIPSING BINARIES BY THE METHOD OF QUICKEST DESCENT. Tabachnik, V. M. (Ushinskii Teachers' Coll., Odessa). Sov. Astron. AJ (Engl. Transl.), 12: 830-9(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 1048-60(Sept.-Oct. 1968).

A supplementary criterion for the best orbital elements of an eclipsing binary star is introduced; it involves the minimum of a quadratic function, which is established by the method of quickest descent. Limb-darkening coefficients, geometric orbital elements, and corrections to the brightness level outside eclipse and to the depths of the brightness minima are determined from light curves for S Cnc and AR Aur. An analysis of the numerical results demonstrates that the solutions of the light curves are unique. (auth)

25032 NEUTRINO RADIATION DURING STELLAR COLLAPSE. Guseinov, O. Kh. (Shemakha Astrophysical Observatory, Baku). Sov. Astron. AJ (Engl. Transl.), 12: 783-7(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 985-90(Sept.-Oct. 1968).

When a star suffers catastrophic contraction, processes occur involving the formation of neutrino pairs can be recorded at the Earth. The energy spectrum and maximum yield of neutrinos are estimated for stars whose mass at the collapse point (when catastrophic contraction sets in) is between 1.6 and 4$M_\odot$. The URCA processes are the principal reaction in neutrino pair formation. The neutrino and antineutrino energies are of order 30 to 70 MeV, while the energy radiated per unit mass of material is (1 to 4) × 10^{19} ergs/g. The same number of ν and $\tilde{\nu}$ are radiated, namely 0.3 pair per nucleon. Since the e^- energy is over twice the e^+ energy, the ν will have twice the energy of the $\tilde{\nu}$ in the URCA processes. If the absorption of ν or if more massive stars are considered, the role of the URCA processes will diminish while the annihilation of e^-, e^+ will be enhanced, so that the ν and $\tilde{\nu}$ energies will become comparable. If retardation (or arrest) of the star's contraction is admitted, the rate of ν, $\tilde{\nu}$ emission will be smaller, but their total number will again be large. The energy of the emitted ν, $\tilde{\nu}$ will be ≈10 MeV, so that against the background of solar ν it would not be possible to observe neutrinos (if their direction of motion has not been established), whereas $\tilde{\nu}$ would be observable. (auth)

25033 THE RADIATION OF THE REFLECTION NEBULAE AROUND MEROPE AND MAIA. Artamonov, B. P. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 773-8(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 973-9(Sept.-Oct. 1968).

The form of the scattering indicatrix is derived by Sobolev's method from an analysis of photoelectric observations of the nebula around Merope. For dielectric spheres with a refractive index m = 1.33 a mean particle size of ≈2×10^{-6} cm is obtained, in agreement with the observations. With this mean particle size, the observational data are analyzed more carefully in terms of a spherical model nebula with a centrally located illuminating star. Satisfactory agreement with observation is obtained for a model nebula comprising a sphere with an internal cavity, which could form through radiation pressure of the star on the dust grains. (auth)

25034 IDENTIFICATION OF THE ABSORPTION SPECTRUM OF THE TYPE I SUPERNOVA. Pskovskii, Yu. P. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 750-6(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 945-52(Sept.-Oct. 1968).

An identification of the minima in the spectrum of a Type I supernova is presented in terms of their being absorption features. Due to distortion of the absorption lines by the expansion of the supernova's envelope (the minimum is shifted toward the violet, the depth is reduced, and the wings are broadened asymmetrically) one can notice only strong lines in their spectra. Under the conditions of exceedingly low density of a supernova envelope such lines should be those which are sensitive to the luminosity effect and also those of generally abundant helium. After the identification of minima in the red region with a blend of a Si II doublet and with the D_2 line of helium, the shift of the remaining minima to the violet with respect to the laboratory wavelengths was calculated, and it was discovered that the minima agreed with the strongest lines of singly ionized elements similar in first ionization potentials to Si II (Fe II, Mg II, Ca II, S II). The violet shift of the minima of the remaining identifications varied from −0.033 to −0.029 and was -0.0307 ± 0.0003 on the average. If this shift constitutes $^2/_3$ of the maximum Doppler shift due to the expansion of the envelope, then a speed for the envelope of a Type I supernova of the order of 13,500 km/sec is obtained, which is similar to that for the remnant of the supernova of Tycho. (auth)

25035 GAS MOTIONS IN DIFFUSE NEBULAE AND STELLAR WIND. Pikel'ner, S. B.; Shcheglov, P. V. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 757-64 (Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 953-61(Sept.-Oct. 1968).

Observations of diffuse nebulae with a high-contrast Fabry–Perot etalon have shown that gas motions with velocities of 50 to 100 km/sec exist in nebulae surrounding O stars. These motions are discussed within the framework of a hypothesis according to which the stellar wind from the O stars interacts with the gas of the nebulae. An envelope consisting of two layers is formed through this interaction, the outer layer being bounded by the shock wave in the nebular gas and the inner layer by the shock wave in the stellar wind. The temperature of the inner layer is about 4×10^5°K and cooling is negligible. The pressure in the inner layer is a function of the radius of the inner shock front R_1. The motion of the envelope is calculated numerically and the observed velocities in it correspond to a radius $R \approx 1$ to 2 pc. The x-ray emission from the inner layer is below the level that can be detected by modern techniques. The cooling of the gas in the outer layer and its structure and radiation emission are calculated. The principal layer has a particle concentration $N \approx (1\text{-}2) \times 10^3$ cm^{-3}, a thickness of about 5×10^{-3} pc, and the ion lines originating in it are slightly broadened. Proposals for further observations are made. (auth)

25036 STARS THAT DO NOT TWINKLE OUTSIDE THE EARTH'S ATMOSPHERE. Cuningham, W.; Libby, L. M. Nature (London), 222: 253-4(Apr. 19, 1969).

It was observed on Apollo 7 and 8 that stars viewed outside the Earth's atmosphere show no obvious variations of visible light intensity over time lapses from tenths of a second up to several minutes. Some aspects of the importance of this observation are discussed. The observation indicates that the effect of moving electron density irregularities in interstellar plasma is small. It is stated that a search for and study of twinkling from the advantageous position of a Moon-based astronomical observatory will offer a new method for determining the distances to stars and may give new information on the problem of quasars. In principle, random motions of interstellar plasma would become amenable to study throughout the galaxy. The absence of visible star twinkling also excludes random laser action in stellar atmospheres and gaseous nebulosities for time variations from tenths of a second up to several minutes. Observations are tabulated for a large number of stars, as used for astronaut navigation. (UK)

25037 TOROIDAL STAGES IN STELLAR EVOLUTION. Porfir'ev, V. V.; Shulman, L. M.; Zhilyaev, B. E. (Ukrainian Academy of Sciences, Kiev). Nature (London), 222: 255-6 (Apr. 19, 1969).

It is stated that one of the questions that the modern theory of stellar evolution fails to explain is why there are no stars rotating with extreme equatorial velocities. The rotation of protostars is restricted because of the conservation of angular momentum during contraction, but if the type of rotation remains unchanged, angular velocity should be related to the radius of the protostar, leading to the result that the angular momentum of a protostar should exceed that of main-sequence stars by 10^4. Removing this difficulty by taking account of magnetic fields, the problem arises as to why magnetic stars rotate rapidly when they should have lost their angular momentum; furthermore, it is not easy to explain why the rotational velocities of stars of early spectral type increase with radius. Problems also arise as to the origin of close binary systems, and further difficulties arise in connection with the polar character of the stellar magnetic field. It seems likely that all these problems arise because the only figure of equilibrium considered in the theory of stellar evolution is the ellipsoid of revolution; decrease of moment of inertia and considerable increase of angular velocity during evolution are consequences of this assumption. If the rotation, however, is nonuniform, it can be shown that the figure of equilibrium should be other than ellipsoidal. The boundary surface of the cloud of gas and dust may be such that the cloud will contract into a toroid. The hypothesis discussed is that the initial rotating cloud contracts into a two-binding body which degenerates into a thin toroid; the moment of inertia in such a process will not change considerably and hence the rotational velocity remains small. The hypothesis appears capable of removing the difficulties mentioned. (UK)

25038 MODEL ATMOSPHERES FOR YELLOW SUPERGIANTS. Parsons, Sidney B. (Case Western Reserve Univ., Cleveland). Astrophys. J., 18: Suppl. Ser. No. 159: 127-65(Apr. 1969).

A grid of fifteen nongray models, designed to represent realistically the atmospheres of F- and early G-type supergiants, is computed for effective temperatures in the range 5400 to 6600°K and for surface gravities log g (cm sec^{-2}) = 1.2, 1.8, and 2.4. All aspects of the construction of the models are discussed in detail. The flux due to convection, significant in the deeper regions, is calculated from mixing-length theory with a mixing length to pressure scale height ratio of 1.0 and a nonlocal calculation of the speeds of convective elements. The important line-blanketing effect is included in the calculation of the radiative flux by a statistical treatment which allows variation of the estimated line absorption with depth. The temperature distributions are found to be sensitive to the way in which blanketing is included. Each model is iterated to near-constancy of total flux with modified Mihalas temperature-correction equations. Within the grid of models there is a transition from thin, atmospheric hydrogen convection zones to deep zones extending well below the atmospheres. (auth)

25039 ON THE RADIAL PULSATION FREQUENCIES OF DENSE WHITE DWARFS. Baglin, A. (Institut d'Astrophysique, Paris). Astrophys. Lett., 3: 119-21(Apr. 1969).

It is shown that the period of radial oscillations for white dwarfs is appreciably affected by the contribution of the ion gas near the region of minimum period. The correction becomes appreciable for central temperatures of the order of 5×10^7 degrees. (auth)

25040 OBSERVATIONAL TIME-SCALES FOR DEPLETION OF LITHIUM IN MAIN SEQUENCE STARS. Danziger, I. J. (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. Lett., 3: 115-18(Apr. 1969).

New abundance data for the Coma Cluster are combined with older data and normalized to a consistent system to show that an e-folding time-scale of approximately 7×10^8 years is indicated for the depletion of lithium in main-sequence stars of approximately one solar mass. Observations of G, K, and M main-sequence field stars reveal some unusually high abundances of lithium. (auth)

25041 INFRARED ASTROPHYSICS. Low, Frank J. (Univ. of Arizona, Tucson. Rice Univ., Houston, Tex. Infrared Labs., Inc., Tucson, Ariz.). Science, 164: 501-5(May 2, 1969).

Advances in detection and instrumentation in the infrared region are briefly reviewed. These advances have greatly expanded the observational capabilities of astronomers. Discoveries of infrared stars and related objects have provided a new opportunity for observing the early stages of stellar evolution and the formative stages of planetary systems like our own. The infrared galaxy phenomenon poses unanswered questions in fundamental physics, reveals new aspects of galactic evolution, may help solve certain parts of the cosmological problem, and could conceivably lead to a new method of energy production. (auth)

25042 NOTE ON THE MAGNITUDE DIAMETER RELATIONSHIP OF 12013 STARS IN THE OXFORD ASTROGRAPHIC ZONES +28° AND +29°. Goyal, A. N.; Mithal, S. S. (Univ. of Rajasthan, Jaipur, India). Proc. Nat. Inst. Sci. India, Part A, 34: 360-3(Nov. 1968).

The Oxford diameters of 12013 stars in the Oxford Astrographic Catalogues +28° and +29° were compared with Cambridge magnitudes. The empirical relation $D = a + b \log_{10} T + c(m - \bar{m}) + d(m - \bar{m})^2 + e(C.I.)$ appears to be fairly good. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstract 25122.

25043 RADIO EMISSION OF COMPONENTS A AND B OF THE QUASAR 3C 273. Lipovka, N. M. (Central Astronomical Observatory, Pulkovo, USSR). Sov. Astron. AJ (Engl. Transl.), 12: 889-90(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 1122-3(Sept.-Oct. 1968).

The position of the center of gravity for the radio emission from the quasar 3C 273 at 3.9 cm wavelength was determined with the Large Pulkovo Radio Telescope. The flux density from components A and B of the quasar is estimated. (auth)

25044 POLARIZATION OF THE RADIATION OF TURBULENT PLASMA UNDER COSMIC CONDITIONS. Tsytovich, V. N. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 806-15(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 1016-28(Sept.-Oct. 1968).

The general problem of cosmic electromagnetic radiation as the radiation of a turbulent plasma is discussed. The magnetobremsstrahlung (synchrotron) and plasma radiation mechanisms may be regarded as limiting cases of the radiation of turbulent plasma. General equations of transfer are obtained for electromagnetic radiation in a turbulent plasma, with allowance for polarization effects. These equations describe the variation of the Stokes parameters along the line of sight, as caused both by the polarization effects in the radiation of electromagnetic waves by the turbulent plasma and by the polarization effects in the propagation of the electromagnetic waves through the turbulent plasma. It is pointed out that polarized radiation from a turbulent plasma can appear even in the absence of magnetic fields. The effect of induced polarization of radiation produced under conditions when turbulent plasma is capable of exciting electromagnetic waves (the maser effect) is discussed. The opportunity for induced-polarization effects to arise in certain cosmic objects (such as quasars and pulsars) is estimated. (auth)

25045 APPLICATION OF THE SPECIAL-RELATIVITY PRINCIPLE TO AN INTERPRETATION OF SOME SOURCES OF COSMIC RADIO WAVES. Shklovskii, I. S. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 730-6(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 919-27(Sept.-Oct. 1968).

With the concepts of special relativity theory as a basis, it is shown that the lifetime of the relativistic electrons in the NGC 4486 jet responsible for its optical radiation and x rays will become sufficiently long if one assumes that the relativistic velocity with which the radiating material is ejected from the nucleus of this galaxy corresponds to $\gamma = [1 - (v^2/c^2)]^{-1/2} \approx 10$. For a distant observer the lifetime of the entire jet could then be ≈300 yr. Relativistic effects would enable a secular elongation of the jet to be detected, as well as intensity variations in individual "knots" in the jet. It is suggested that the strong variability recently discovered in 2C 287 may be explained by the effects of special relativity theory, assuming that this quasar is at a "cosmological" distance. If one regards the small source that has been detected at the center of the Crab Nebula as expanding at a relativistic velocity corresponding to $\gamma \approx 20$, its radiation may be explained by the synchrotron mechanism (just as for the sources of variable radio emission in quasars and the nuclei of certain radio galaxies). This mechanism would conform to the observed injection of relativistic electrons in the Crab Nebula at a rate of $\approx 10^{38}$ ergs/sec. The mechanism would also provide a natural explanation for the steepness of the spectrum of the small source in the Crab. It might also explain the steepness of the spectrum of 3C 273 in the range $\lambda = 1$-$100\ \mu$. (auth)

25046 THE CORONA OF A PULSAR: ITS OSCILLATION AND RADIATION. Zel'dovich, Ya. B. (Inst. of Applied Mathematics, Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 725-9 (Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 913-18(Sept.-Oct. 1968).

It is suggested that pulsars represent oscillating white dwarfs surrounded by a hot, rarefied corona. The oscillations would generate periodic shock waves in the corona, and plasma oscillations of electrons in the wave front would produce the observed radio emission. The temperature and density of the corona are estimated. The possibility of a white dwarf oscillating in high overtones is discussed; this explanation would be most probable for a pulsar with a minimum period of 0.25 sec. (auth)

25047 X-RAY EMISSION FROM RADIO GALAXIES AND QUASARS. Komberg, B. V.; Charugin, V. M. (Inst. of Applied Mathematics, Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 737-42(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 928-35(Sept.-Oct. 1968).

With various simplifying assumptions a formula was obtained for calculating the emission flux from an extended source in which scattering occurs of the synchrotron radiation quanta $\rho_\nu \sim \nu\nu^{-\alpha}$ by the relativistic electrons $n_E \sim E^{-m}$ responsible for this radiation. The results of calculations applied to sources of x-ray radiation, the radio galaxy Virgo A and the quasar 3C 273, make it possible to infer that in these objects quanta of the x-ray range are generated in compact central regions of $L \approx 10^{16}$ to 10^{17} cm with a strong magnetic field $H \approx 10^2$ to 10^6 G. The suggestion that x-ray emission is generated in the ejections which are observed to extend from the nuclei of M87 and 3C 273 leads to abnormally small values of the magnetic fields in the ejections, $H \approx 10^{-6}$ to 10^{-8} G, which is evidently contradicted by observations. (auth)

25048 FREQUENCY SPECTRUM OF THE DISTRIBUTED COSMIC RADIO EMISSION IN THE RANGE FROM 6.3 TO 40 MHz. Getmantsev, G. G.; Karavanov, V. S.; Korobkov, Yu. S.; Tarasov, A. F. (Gor'kii State Univ., USSR). Sov. Astron. AJ (Engl. Transl.), 12: 743-6(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 936-41(Sept.-Oct. 1968).

The frequency dependence of the effective temperature of the distributed cosmic radio emission was measured in the range between 6.3 and 40 MHz and the results are given. The effective temperature was measured using antennas with a vertical directional diagram with dimensions of 25° × 35° at half-power points. A series of spectra of the distributed cosmic radio emission is given for various positions of the maximum of the directional diagram, which correspond to galactic latitudes between 20 and 60°. The spectral index of the distributed cosmic radio emission was observed to increase with increasing galactic latitude from $\alpha = 0.4$ for b = 20° to $\alpha = 0.6$ for b = 60°. (auth)

25049 DETECTION OF THE 5765.2-MHz HELIUM RADIO LINE IN THE ORION NEBULA. Gudnov, V. M.; Zotov, V. V.; Nagornykh, L. M.; Sorochenko, R. L. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 747-9(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 942-4(Sept.-Oct. 1968).

The intensity and width of the 104α line of excited hydrogen in the Omega and Orion Nebulae were measured. In addition to the strong hydrogen line the Orion Nebula spectrograms exhibit a weaker line displaced by 2.3 MHz in frequency. This line belongs to the helium spectrum. Its intensity is (23±5)% of the hydrogen-line intensity. (auth)

25050 NEW OH RADIO EMISSION SOURCES IN CYGNUS. Elider, J.; Roennaeng, B.; Winnberg, A. (Chalmers Univ. of Tech., Goteborg). Nature (London), 222: 67-9(Apr. 5, 1969).

Previous radio observational work on OH emission sources is reviewed. NML Cygni radiates the strongest radio emission line so far detected and, since this OH emission source is not associated with any radio continuum emission, it was considered worthwhile to make a survey over a limited region of the sky in an endeavor to find other OH sources not connected with continuum emission; this survey was conducted on several OH frequencies. The equipment employed comprised an 84-ft radiotelescope, a traveling-wave maser, a 100-channel frequency switched receiver, and a small on-line computer. Two sets of filter banks were used, with bandwidths of 10kHz and 1kHz, the former for the search and the latter for more detailed studies, together with CRT display. Four OH emission sources were detected which, it is believed, have not previously been observed; their parameters are tabulated and discussed, and their spectra are shown. (UK)

25051 ESTIMATES OF PULSAR DISTANCES FROM NEUTRAL HYDROGEN ABSORPTION. Gordon, C. P.; Gordon, K. J.; Shalloway, A. M. (National Radio Astronomy Observatory, Green Bank, W. Va.). Nature (London), 222: 129-32(Apr. 12, 1969).

It is stated that measurements of absorption by the pulsar continuum at 21 cm provide information on the neutral hydrogen between the pulsar and the observer, and a lower limit of pulsar distance may be derived from the absorption velocity profile together with a galactic-rotation model. Using this method de Jager et al. (Nature 220: 128(1968)) obtained a distance for CP 0328 of at least 4, and possibly more than 6, kpc. Measurements by Guélin et al. (Nature 221: 249(1968)) did not confirm these values, but gave ~0.8 kpc. The present authors describe repeat absorption measurements on CP 0328, and also measurements on a number of other pulsars, using the 140 ft. NRAO telescope, on Dec. 9–11, 1968 and Jan. 3–9, 1969. The observations were made using a total bandwidth of 2.5 MHz, with individual channels separated by 1.4 km/sec. Results for CP 0328 did not confirm those of de Jager, and when the difference in velocity resolution was taken into account the results agreed with those of Guélin. It is emphasized that absorption measurements provide only a lower limit to distance, and that true distances may be much larger. Absorption featu rarely copy emission features in velocity half-width and intensity, but by combining results on many pulsars meaningful average distances may be estimated. Results for PSR 1749-28 are discussed, particularly with regard to a narrow absorption feature

at 9 km/sec., possibly due to absorption by a cold inter-arm cloud, lying within 1 kpc. No absorption was found for AP 0823+26, CP 0950, and CP 1133. (UK)

25052 HIGH-RESOLUTION MAPPING OF FOUR STRONG RADIO SOURCES AT 80 MHz. Morimoto, M. (Tokyo Astronomical Observatory); Lockhart, I. A. Proc. Astron. Soc. Aust., 1: 99-102(Feb. 1968). (RPP-1160/6).

A number of strong radio sources were examined for structure with the 3.5' beam of the 80 MHz radioheliograph at Culgoora. Contour maps of brightness distribution are presented for the galactic source W44, and the extragalactic sources Fornax A, Dictor A, and 3C 353; they are compared with maps at other frequencies. (W.D.M.)

25053 OBSERVATIONS OF PULSAR NP 0527. Zeissig, G. A.; Richards, D. W. (Arecibo Ionospheric Observatory, Puerto Rico). Nature (London), 222: 150-1(Apr. 12, 1969).

Reference is made to a pulsar in the vicinity of the Crab Nebula observed since Dec. 20, 1968, and having the longest period yet reported for any pulsar. Measurements were made with the 1000-ft radiotelescope at frequencies of 111.5, 196.5, 320, 430, and 611 MHz, and the source was identified as NP 0527. The measurement indicated a period of ~3.75 sec., a value at variance with the NRAO value of <0.25 sec. This disagreement is probably a result of the double-pulse structure of the source, the separation of the two components being <0.25 sec. at 111.5 MHz. Average pulse shapes are shown and discussed; they show a dependence of component separation on frequency similar to that reported for CP 1133, and the data suggest that increase in component separation is occurring in or near the source in both cases, rather than in the interstellar medium. Disassociation of NP 0527 from NP 0532, however, is not certain. Definite conclusions as to physical association between NP 0527 and the Crab Nebula await observations of proper motion and statistical studies of pulsar distribution. (UK)

25054 ATTEMPT TO DETECT X-RAY PULSES FROM THE CRAB NEBULA. Hillier, R. R.; Jackson, W. R.; Murray, A.; Redfern, R. M.; Standing, K. G. (Univ. of Bristol, Eng.). Nature (London), 222: 149-50(Apr. 12, 1969).

Attempts were made to detect pulses of hard x rays from the Crab Nebula at the same repetition rate as the radio and optical pulses, in the energy interval 30 to 120 keV, from balloon flights. An analysis is shown of two 20-min data periods on Aug. 22, 1968. A peak was found representing 0.17% of the total flux recorded by the detector, whereas the steady flux from the Nebula amounted to 2.3% of the total flux. The peak is regarded as an upper limit to the pulsed x-ray flux. The steady flux from the Nebula between 30 and 120 keV is 1.1×10^{-8} ergs/cm^2/sec, and hence a limit of 8.2×10^{-10} ergs/cm^2/sec may be set to the pulsed flux in the same energy region. The limit to the pulsed x-ray flux lies below that suggested by an extrapolation of the optical data, and the total x-ray flux from the Nebula in fact lies below this extrapolation. It is pointed out that any search for pulses of hard x-rays requires analysis of long data periods, and this implies that the repetition rate of the pulses must be known accurately from other data if synchronism with the pulsar is to be maintained. The gravitational red shift at the surface of a neutron star may be as high as 10%, and if the x rays and optical and radio pulses originate at different heights above the surface, their apparent repetition rates may differ. The observed agreement (to one part in 10^8) in the repetition rates of the optical and radio pulses implies that the radiations are emitted from regions separated in height by <10 cm, assuming the neutron star to have a radius of 10 km. (UK)

25055 FURTHER OBSERVATIONS OF THE CRAB NEBULA OPTICAL PULSAR. Warner, B.; Nather, R. E.; MacFarlane, M. (McDonald Observatory, Austin, Tex.). Nature (London), 222: 233-8(Apr. 19, 1969).

Further optical studies of the Crab Nebula pulsar have revealed an unusual shape of the light curve as a function of color and polarization. (auth) (UK)

25056 MASER ACTION IN INTERSTELLAR OH. Robinson, B. J. (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust., 1: 70-3(Feb. 1968). (RPP-1160/1).

Since 1965 attempts have been made to unravel the curious properties of the intense 18-cm emission lines observed from interstellar OH molecules. The most plausible hypothesis is that of naturally occurring interstellar gas masers. Some of the latest evidence in favor of the maser action is presented, and areas where the evidence is inadequate are pointed out. Primary consideration is given to work done in 1967. (W.D.M.)

25057 DETECTION OF A CHANGE OF STATE IN THE PULSAR PSR 0833-45. Radhakrishnan, V.; Manchester, R. N. (Commonwealth Scientific and Industrial Research Organization, Sydney). Nature (London), 222: 228-9(Apr. 19, 1969).

The pulsation period of PSR 0833-45 is known to be gradually increasing, but between February 24 and March 3, 1969 the periodicity abruptly decreased by two parts per million. Attempts are made to account for this change. (auth) (UK)

25058 OBSERVED DECREASE IN THE PERIODS OF PULSAR PSR 0833-45. Reichley, P. E.; Downs, G. S. (California Inst. of Tech., Pasadena). Nature (London), 222: 229-30(Apr. 19, 1969).

An abrupt decrease in the period of PSR 0833-45 was detected at the Goldstone Tracking Station of the Jet Propulsion Laboratory. (auth) (UK)

25059 MAGNETIC MODELS OF PULSARS AND ROTATING NEUTRON STARS. Ginzburg, V. L.; Zaitsev, V. V. (Lebedev Inst. of Physics, Moscow). Nature (London), 222: 230-1(Apr. 19, 1969).

A description is given of how magnetic models of pulsars can account for the narrowness of the beam of radiation. (auth) (UK)

25060 DIGITAL SEARCH METHODS FOR PULSARS. Lovelace, R. V. E. (Arecibo Ionospheric Observatory, Puerto Rico); Sutton, J. M.; Salpeter, E. E. Nature (London), 222: 231-3 (Apr. 19, 1969).

How to search for weak pulsars in the radio noise picked up by telescopes is discussed. Two kinds of analysis are described; both have been used successfully at Arecibo. (auth) (UK)

25061 ON THE OPTICAL IDENTIFICATION OF 3C 230. Gent, H.; Adgie, R. L.; Crowther, J. H. (Royal Radar Establishment, Great Malvern, Eng.). Nature (London), 222: 253(Apr. 19, 1969).

Studies are described using the RRE interferometer at 2,695 MHz. 3C 230 was of particular interest since its radio position disagreed with that of a previously suggested optical identification and supported an alternative optical candidate. It is stated that in view of such uncertainties 3C 230 should be removed from the list of identified quasars. (UK)

25062 SOME FURTHER PULSAR OBSERVATIONS AT THE MOLONGLO RADIO OBSERVATORY. Large, M. I. (Univ. of Sydney). Astrophys. Lett., 3: 123-8(Apr. 1969).

Four new pulsars were detected and more accurate parameters are given for two others detected earlier at Molonglo. One of the new pulsars has a very high dispersion measure, namely 220 cm^{-3} pc. It was discovered with a new "dispersion-removing" technique. It is suggested that the mean flux density of pulsars decreases with age and that the typical lifetime of a pulsar is 5×10^6 years. (auth)

25063 INTENSITIES OF RADIO RECOMBINATION LINES. Hjellming, R. M. (National Radio Astronomy Observatory, Green Bank, W. Va.); Andrews, M. H.; Sejnowski, T. J. Astrophys. Lett., 3: 111-14(Apr. 1969).

Strengths of α- and β-radio recombination lines are predicted for $40 \leq n \leq 225$ for H (II) regions with T_e = 5000, 7500, and 10,000°K, $N_e = 10^2$, 10^3, 10^4 cm^{-3}, and emission measures from 10^4 to $10^{7.5}$ pc cm^{-6}. (auth)

25064 DYNAMIC SPECTRA OF PULSARS. Huguenin, G. R. (Univ. of Massachusetts, Amherst); Taylor, J. H. Astrophys. Lett., 3: 107-10(Apr. 1969).

Dynamic spectra were observed for 13 pulsars. The data suggest that existing models of interstellar scintillation cannot account for all of the observed spectral phenomena. (auth)

25065 TIME VARIATIONS IN GALACTIC OH EMISSION SOURCES. Zuckerman, B. (Univ. of Maryland, College Park); Ball, J. A.; Dickinson, D. F.; Penfield, H. Astrophys. Lett., 3: 97-101(Apr. 1969).

Time variations were found in the OH emission sources in W49 and W75. A new OH emission source was found in W75, and the region around it was studied in the continuum near 2 and 4 cm. (auth)

25066 QUASI-STELLAR OBJECTS AND RADIO GALAXIES. Surdin, Maurice (Faculte des Sciences de Bordeaux, Talence, France). Compt. Rend., Ser. A, B, 268: 510-13(Feb. 10, 1969).

The application of the mechanism of fluctuating magnetic fields of ionized clouds to quasi-stellar objects, considered as radio galaxies in formation, leads to interesting results. (tr-auth)

25067 STRUCTURE AND EVOLUTION OF QUASI-STELLAR RADIO SOURCES. Tabara, Hiroto (Rikkyo Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 40: 1354-88(Dec. 1968).

The recently improved observational data on the quasi-stellar radio sources (QSS) and on the radio galaxies are analyzed to put forward the theory of the structure and evolution of QSS, along the model proposed by Aizu, Fujimoto, Hasegawa, Kawabata, and

Taketani (AFHKT). It results from the present analysis that the model proposed by AFHKT is confirmed generally by the recent data. In the course of the present analysis, the nonuniform model of the nucleus of a galaxy is proposed, in which local condensations with stars and gas are assumed to exist. Explosions taking place successively and/or simultaneously in the condensations, are shown to account for the essential features of the QSS. Constructing again the luminosity L versus volume emissivity L/V diagram from recent data, it is found that there exists an upper envelope under which almost all the plotted sources are located. The evolutionary path along the upper envelope is seen to be divided into three stages, that is, the optical, radio, and remnant stages. The optical stage corresponds to the formation of the core with size of ~1 kpc. During this stage many small components, with size of ~1 pc and formed by the explosion of condensations, appear successively. The radio stage corresponds to the formation of the halo and, finally, the remnant stage to the expansion of the halo with size of ~50 kpc. A characteristic feature newly found here about the evolutionary path along the upper envelope is that the luminosity is nearly constant during the optical and radio stages. The upper envelope has a slope of about $\frac{1}{2}$ during the remnant stage as was discussed by Aizu, Fujimoto, Hasegawa, and Taketani. To explain the flat part of the evolutionary path along the upper envelope, a nonuniform structure of the radio core composed of clouds or filaments is proposed. From a statistical analysis it is concluded that the evolution of QSS along the upper envelope is a special case and most of QSS leave the upper envelope during the radio stage with the decreasing luminosity. It is found that there are two groups of QSS, named the Q and G groups. It is shown that the optical phenomena associated with QSS in the G group can be considered to be independent of its present radio emission and due to a new explosion. It is pointed out that the optical properties of QSS in the G group may be similar to those of QSS in the Q group or to those of the quasi-stellar galaxies (QSG). (auth)

Solar Phenomena

Refer also to abstracts 25130, 25182, 25198, 25212, and 25509.

25068 (AD-674896) PHYSICS OF THE SOLAR CORONA. Final Report, February 1, 1967–August 31, 1968. Billings, Donald E. (Colorado Univ., Boulder). Aug. 31, 1968. Contract N00014-67-C-0290. 6p. CFSTI.

Temperature and density distribution in an active coronal enhancement are determined from Naval Research Laboratory spectroheliograms. A study of variation in mean coronal temperature with time during a solar cycle is reported. Progress is reported in a new determination of coronal chemical abundance from optical emission lines, and studies are reported dealing with the structure and evolution of coronal enhancements, and on monochromatic optical observations. (auth) (USGRDR)

25069 (AD-677314) PLASMA PHYSICS AND RELATED TOPICS IN ASTROPHYSICS. Final Report. Sturrock, P. A. (Stanford Univ., Calif. Inst. for Plasma Research). Aug. 1968. Contract AF49(638)-1321. 11p. (SU-IPR-257; AFOSR-68-1890). CFSTI.

This research has been concerned primarily with plasma phenomena of solar physics. Some phenomena of general interest were studied; some of the solar problems involve plasma physics in only a minor way. However, the central theme of the research program has been the study of solar flares, solar radio bursts, and of structures such as filaments and streamers (all of which involve plasma processes), and the development of plasma physics theories to help understand these and related phenomena. (auth) (USGRDR)

25070 RELATIVISTIC THEORY OF ANNUAL PARALLAXES. Arifov, L. Ya.; Kadev, R. K. (Inst. of Nuclear Physics, Tashkent). Sov. Astron. AJ (Engl. Transl.), 12: 882-8(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 1114-21(Sept.-Oct. 1968).

The contribution and influence of the Sun's gravitational field on the measurement of annual trigonometric parallaxes are investigated in terms of general relativity theory. Experimental data in accord with the implications of theory are presented. (auth)

25071 INTENSITY DISTRIBUTION FOR THE 5303 A CORONAL LINE ALONG THE SOLAR LIMB. Gnevyshev, M. N.; Chistyakov, V. F. (Central Astronomical Observatory, Kislovodsk, USSR). Sov. Astron. AJ (Engl. Transl.), 12: 816-21(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 1029-36(Sept.-Oct. 1968).

A study was made of the annual mean values for the intensity of the 5303 Å coronal line as observed at the Pic du Midi and Kislovodsk coronal stations in 1954–1965. Relationships were established for the intensity distribution along the limb and for the variations in the distribution over the 11-yr cycle. It is shown that: 1) the variations in the mean density of the coronal radiation occur synchronously in each hemisphere of the Sun at all latitudes; 2) the presence of two activity maxima during the 11-yr cycle is confirmed; 3) in each hemisphere the intensity distribution of the coronal radiation along the limb relative to the latitude of maximum intensity follows a random error law at low and intermediate latitudes; 4) the mean intensity of the radiation at the equator results from a mutual overlapping of the statistical activity distributions for the two hemispheres. (auth)

25072 DENSITIES IN THE EMISSION REGIONS OF IONIZED METALS IN THE LOWER CHROMOSPHERE. II. Shilova, N. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Propagation, Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 826-9(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 1043-7(Sept.-Oct. 1968).

The hydrogen concentration n_H is determined in the regions where Be^+ and Sc^+ lines are emitted at heights of 1000 to 2000 km in the lower chromosphere. This analysis, together with previous determinations of n_H from Ti^+, Y^+, and Fe^+ emission lines, indicates that the emission regions for most ionized metals in the lower chromosphere either have a concentration of $n_H \approx 5 \times 10^{11}$ cm^{-3}, or they occupy only 2 to 3% of the extent of the chromosphere along the line of sight. One unit on Mitchell's visual intensity scale is shown to correspond to an absolute line intensity of 6.8×10^2 ergs/cm^2 · sec in the lower chromosphere. (auth)

25073 RADAR OBSERVATIONS OF THE SUN AND A MECHANISM FOR PRODUCING THE REFLECTED SIGNAL IN THE CORONA. Gordon, I. M. (Inst. of Radiophysics and Electronics, Kiev). Sov. Astron. AJ (Engl. Transl.), 12: 796-805(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 1002-15(Sept.-Oct. 1968).

The results of radar observations of the Sun at 38.25 MHz are analyzed. It is suggested that a substantial portion of the components of the reflected signal is formed through Raman scattering by low-frequency ionosonic oscillations in the coronal plasma. This hypothesis provides an explanation for the exceptionally wide range of variation observed in the effective cross section, from (20 to 30)$\pi R_\odot^2$ down to a few hundredths of $\pi R_\odot^2$, as well as for the high correlation with the area of the flocculi, from which a high directivity for the reflected signal may be inferred. A natural explanation is also afforded for the presence of reflections at heights as great as $2.7R_\odot$, for the large amplitude of the frequency shifts, and for the decrease in the shift with height for $R > 1.6R_\odot$. (auth) (TSS)

25074 PRELIMINARY OBSERVATIONS OF THE SUN AT 80 MHz WITH THE CULGOORA RADIOHELIOGRAPH. Kai, K.; McLean, D. J.; Payten, W. J.; Sheridan, K. V.; Wild, J. P. (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust., 1: 79-81(Feb. 1968). (RPP-1160/5).

This paper describes a preliminary series of observations of the Sun at 80 MHz with the 3-km radioheliograph of the Culgoora Observatory. The instrument records, at 1-sec intervals, pictures of the solar image in the form of 60(E−W) × 48(N−S) points, each separated in angle by half the Rayleigh limit (2′ arc in the zenith). The series of observations was made between about 0^h and 4^h UT on the 6 days between Oct. 26 and 31, 1967. This was a period of weak Type I storm activity with occasional Type III bursts and one example each of a Type V and Type II burst. (W.D.M.)

25075 RESULTS OF RADIO OBSERVATIONS OF IRREGULARITIES IN THE INTERPLANETARY PLASMA, 1965–1966. Antonova, T. D.; Vitkevich, V. V. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 788-95(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 991-1001(Sept.-Oct. 1968).

The results of two years of scintillation observations are reported. Empirical data for the scintillation measure of the sources 3C 48, 3C 144H, and 3C 298 are displayed in graphs, and histograms are given for the values of the scintillation quasiperiod. Variations in the mean scintillation measure are detected, with a characteristic time of approximately 1 to 1.5 yr. The scintillation of 3C 144H at 7.9 m wavelength can be followed to angular distances $\varphi \approx 180°$ from the Sun. The rms value of the fluctuations in electron concentrations in the interplanetary medium is computed for distances from 0.6 to 1.3 AU. At 1 AU this quantity is equal to 1 el/cm^3. (auth)

25076 PERIODIC STRUCTURE IN SOLAR RADIO BURSTS AND ITS RELATION TO BURST ENERGY. Cribbens, A. H.; Matthews, P. A. (University Coll., London). Nature (London), 222: 158-9(Apr. 12, 1969).

Reference is made to observations of solar radio emission made

during the period Nov. 1967 to Oct. 1968 at the Radio and Space Research Station, Slough, using a correlation type polarimeter at 2.8 GHz. It was found that many bursts which looked simple in form when recorded at 3 in./hr. were resolved at higher recording speeds into complex structures, some of which were extremely impulsive. Some details are given of the large burst on June, 1968, which showed a well-defined periodic structure with sharply defined peaks of intensity spaced at 385 ± 15 sec. A further 13 examples of bursts of this type were also found. Attempts were made to relate the observed periodicity to some other property of the bursts, and the periodic time was plotted against the burst peak intensity on logarithmic scales. A tendency was found for long periodic times to be associated with bursts of large intensity, and in view of this the possibility that there might be a more consistent relationship between the periodic time and the total burst energy was investigated; such a relationship was found. (UK)

25077 TRANSITS OF MERCURY AND THE SIZES OF SMALL SOLAR FEATURES. Hyder, Charles L. (Sacramento Peak Observatory, Sunspot, N. Mex.). Solar Phys., 6: 482-4 (Mar. 1969).

There will be two transits of mercury, one on May 9, 1970 and the other on Nov. 10, 1973. During the transits one has an opportunity to determine one-dimensional scale sizes of small-scale solar features as they are occulted by and as they emerge from behind mercury. Some of the possible experiments are mentioned. (W.D.M.)

25078 SOLAR MAGNETIC-FIELD MEASUREMENTS USING BABINET COMPENSATORS. Beckers, J. M. (Sacramento Peak Observatory, Sunspot, N. Mex.); Stenflo, J. O. Solar Phys., 6: 480-1 (Mar. 1969).

Recently Stenflo (1969) described a method of measuring longitudinal solar magnetic fields by means of fringes introduced in spectroheliograms by alternately using a + and $-\lambda/4$ plate in front of the entrance slit. A similar result can be obtained by replacing the varying $\lambda/4$ plate with a stationary Babinet compensator whose fringes are parallel to the spectrograph dispersion. Polarization of the incident light will result in a fringe pattern in the spectroheliogram. A magnetic field on the Sun will, therefore, show up by the presence of fringes. (W.D.M.)

25079 SIMULTANEOUS PLASMA AND MAGNETIC-FIELD MEASUREMENTS OF PROBABLE TANGENTIAL DISCONTINUITIES IN THE SOLAR WIND. Siscoe, George L.; Turner, James M.; Lazarus, Alan J. (Massachusetts Inst. of Tech., Cambridge). Solar Phys., 6: 456-64 (Mar. 1969).

Changes in magnetic-field and plasma data from Pioneer 6 across selected discontinuities are found to agree with those predicted for tangential discontinuities. Substantial velocity shears are found across the discontinuities, the largest observed being about 80 km/sec. For the observation of velocity shears and of the asymmetry in the orientation of tangential discontinuities, an east-west asymmetry in the solar-wind speed is inferred: Fast streams should tend to come from the west and slow streams from the east with respect to the average direction. This effect is discussed in relation to the rotation of the Sun. (auth)

25080 MODEL OF INTERPLANETARY AND CORONAL MAGNETIC FIELDS. Schatten, Kenneth H. (Univ. of California, Berkeley); Wilcox, John M.; Ness, Norman F. Solar Phys., 6: 442-55 (Mar. 1969).

A model of the large-scale magnetic field structure above the photosphere uses a Green's function solution to Maxwell's equations. Sources for the magnetic field are related to the observed photospheric field and to the field computed at a "source" surface about 0.6 $R_\odot$ above the photosphere. The large-scale interplanetary magnetic field sector pattern is related to the field pattern at this "source" surface. The model generates magnetic field patterns on the "source" surface that compare well with interplanetary observations. Comparisons are shown with observations of the interplanetary magnetic field obtained by the IMP-3 satellite. (auth)

25081 HIGH-RESOLUTION OBSERVATIONS OF SOLAR RADIO BURSTS WITH MULTI-ELEMENT COMPOUND INTERFEROMETERS AT 3.75 AND 9.4 GHz. Enome, Shinzo; Kakinuma, Takakiyo; Tanaka, Haruo (Nagoya Univ., Japan). Solar Phys., 6: 428-41 (Mar. 1969).

High-resolution observations of solar radio bursts made simultaneously with multi-element compound interferometers at 3.75 and 9.4 GHz are presented. Preliminary results are: (1) The burst of December 16, 1967 showed a change in polarization distribution in the radio source, which suggests a magnetic field change in the source. (2) The existence of the multi-source burst is also confirmed at 3.75 GHz. (3) The source size of the impulsive burst is estimated to be ≈0'.5. (4) Among the GRF bursts there seem to be two kinds; one has a large angular size and the other has a small one. A brief discussion is given of the burst of December 16, 1967. (auth)

25082 LARGE-SCALE MUTUAL RELATIONS OF SPOT GROUPS IN PROTON COMPLEX. Krivsky, L.; Obridko, V. (Astronomical Inst., Ondrejov, Czech.). Solar Phys., 6: 418-27 (Mar. 1969).

The large-scale configuration of spot groups was investigated within a complex proton region. The probability of occurrence of accompanying spot groups (satellites) was studied according to the classification types, the direction of their occurrence, and the distance with respect to the proton spot group. The results obtained indicate that the condition for the generation of a proton spot group will not only rest with the known small-scale interaction of a few magnetic systems and the creation of a single group, but also with the existence of "satellites" in the neighborhood of the proton group up to a distance of several tens of degrees. (auth)

25083 CENTER-TO-LIMB VARIATION OF SUNSPOT BRIGHTNESS. Mattig, W. (Fraunhofer Inst., Freiburg i. B.). Solar Phys., 6: 413-17 (Mar. 1969).

A preliminary analysis of recent measurements of the brightness ratio spot–photosphere of various authors leads to the result, that the limb darkening of the umbra is considerably less than that of the photosphere. The small value of the center-to-limb variation implies a very small temperature gradient, which is, for optical depths $\tau > 0.2$, about one order of magnitude smaller than previously thought. This result would seem to rule out radiative equilibrium in the deeper layers ($\tau > 0.2$) of sunspot umbrae. (auth)

25084 AN EMPIRICAL INTERPOLATION FORMULA FOR THE IONIZATION CROSS SECTIONS OF HYDROGEN-LIKE IONS. Jacobs, A. (Space Research Lab., Utrecht). Solar Phys., 6: 410-12 (Mar. 1969).

Interpolation formulae as a function of the atomic number were found for the two parameters in Drawin's empirical expression for the ionization cross-section from the ground level of hydrogen-like ions. A few ionization coefficients for C^{5+}, N^{6+} and O^{7+} are given. (auth)

25085 THE ENERGY DISTRIBUTION IN THE SOLAR EUV SPECTRUM AND ABUNDANCE OF ELEMENTS IN THE SOLAR ATMOSPHERE. Nikolskii, G. M. (Inst. for Terrestrial Magnetism, Ionosphere, and Propagation of Radiowaves, Moscow). Solar Phys., 6: 399-409 (Mar. 1969).

An absolute calibration of the solar euv spectrum is given. The corresponding energy distribution is shown. During the minimum solar activity the radiation flux in the range below 1027 Å near the Earth is 2.6 erg/cm² sec, in the maximum it is 8 erg/cm² sec. Abundances of fifteen elements in the solar atmosphere were deduced from a comparison of predicted and observed intensities of more than 300 lines in the spectral region below 1215 Å. (auth)

25086 ABUNDANCES OF HEAVY ELEMENTS IN THE SUN. Grevesse, Nicolas (Univ., Liege). Solar Phys., 6: 381-98 (Mar. 1969).

Solar abundances were derived for Pb, Bi, Th, and U. For the three first elements, the abundances were determined from the profiles of their lines obtained with the high resolution solar spectrometer installed at the Jungfraujoch Scientific Station (Switzerland) and from new oscillator strengths based on life-time measurements (Pb and Bi). The possible presence of U in the solar spectrum was also examined. The results were (in the $\log N_H = 12.00$ scale): $\log N_{Pb} = 1.83$, $\log N_{Bi} \leq 0.80$, $\log N_{Th} = 0.82$, and $\log N_U \leq 0.60$. The meaning of these new solar abundances is discussed from the point of view of the nucleosynthesis theories. (auth)

25087 TEMPERATURE FLUCTUATIONS IN THE SOLAR PHOTOSPHERE. Wilson, P. R. (Joint Inst. for Lab. Astrophysics, Boulder, Colo.). Solar Phys., 6: 364-80 (Mar. 1969).

The general problem of interpreting granulation data, in particular Edmonds' r.m.s. intensity fluctuation distribution against heliocentric angle θ, is discussed. A method is developed for investigating a variety of models of inhomogeneous departures from radiative equilibrium using two dimensional solutions of the equation of radiative transfer, and theoretical r.m.s. intensity fluctuation distributions are computed. It is found that only a very narrow range of models yields distributions which exhibit the essential features of Edmonds' distribution (a center-of-disk value of 14% and a maximum value of 20.5% at a heliocentric angle of 53°). The feature of these models is a maximum in the temperature fluctuations of about 660 K r.m.s., which represents a temperature difference between hot and cold regions of 2000 K, at a depth of about 250 km below $\tau_{5000} = 0.03$. Below this the temperature fluctuations decrease rapidly in the next 70 km. These re-

sults are interpreted in terms of convective and radiative transport of energy. Velocities of the order of 8 km/sec are deduced in the essentially convective regime near 320 km, decreasing through 4 km/sec near the temperature fluctuation maximum to negligible values in the radiative region above 200 km. These features are shown to be consistent with modern theoretical and laboratory studies of convection in incompressible fluids. Further, these studies indicate that a second temperature fluctuation should occur at the bottom of a convective layer. For this reason, further photospheric models are studied in which, below the region of small temperature fluctuations near 320 km, the fluctuations increase sharply. For one of these models a theoretical intensity r.m.s. distribution is obtained which closely fits not only the maximum at $\theta = 53°$ in Edmonds' observed distribution but also the initial decrease and smaller minimum near 24°. (auth)

25088 SPACE SPECTRUM OF CONVECTIVE INSTABILITY. Zilyaev, B. E. (Main Astronomical Observatory, Kiev). Solar Phys., 6: 351-63(Mar. 1969).

Growth rates were obtained for convective disturbances propagating in an atmosphere with a linear variation of entropy. The dispersion equation for small-scale disturbances in the parabolic entropy diagram case is considered by means of the WKB approximation. It is shown for that case that the small-scale disturbances are reflected inside the convective zone and so cannot be observed at the Sun's surface. If the atmosphere is polytropic, it is shown that the small-scale disturbances can easily reach the Sun's surface. (auth)

25089 UPPER LIMIT FOR THE SOLAR NEUTRON FLUX IN THE ENERGY INTERVAL 20 TO 120 MeV. Forrest, D. J.; Chupp, E. L. (Univ. of New Hampshire, Durham). Solar Phys., 6: 339-50(Mar. 1969).

An experiment was performed to search for the existence of a flux of solar neutrons at the Earth using a detector sensitive to neutrons in the energy region 20 to 120 MeV. The instrument was carried by balloon to an atmospheric depth of ≈ 4 g/cm^2, from Palestine, Texas on the morning of November 2, 1967 and flown through sunrise and for about 7 hours into the day. Numerous flares of importance 1B or less occurred during the float period. By comparison of night and day counting rates it was deduced that the upper limit to the continuous emission of solar neutrons at the Earth is $\approx 2 \times 10^{-2}$ neutrons/cm^2 sec in the above energy region. Using a theoretical form for the neutron differential energy spectrum this result was expressed as an upper limit differential solar neutron flux. If neutrons were emitted in association with any of the small flares then the maximum flux at the Earth was less than $\approx 4 \times 10^{-2}$ neutron/cm^2 sec in the same energy region. The minimum detectable flux with the present instrument is therefore well below the predicted flux from a 3B flare (e.g., Nov. 12, 1960) of 5 — 50 neutrons/cm^2 sec. (auth)

25090 SOLAR FLARE EFFECT ON VLF CHORUS. Hayashi, K.; Kokubun, S.; Oguti, T. (Tokyo Univ.). Rep. Ionosphere Space Res. Jap., 22: 285-7(Dec. 1968).

Solar flare effects on polar chorus variation, based on vlf data obtained at Syowa Base, Antarctica, are reported. Chorus intensity decreases, associated with solar flares, were observed for several cases from the comparisons of vlf records at Syowa Base with magnetograms from low-latitude stations. (W.D.M.)

25091 A NOTE ON THE REAL EXISTENCE OF STABLE STAGES IN SUNSPOT GROUPS EVOLUTION. Kopecky, M. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech., 20: 30-2(1969).

The curves of the frequency distribution N(S) of spot groups according to their area S show a slow-down in the drop of N(S) with growing S, or, simply, "steps," as has been found by Dmitrieva et al., (1968a, 1968b) in the region of areas S = 60 to 200 millionths. The real existence of these steps in the curves of N(S) is substantiated, in the present note, by their regular occurrence in the N(S) curves drawn from the Greenwich observational material for different distances from the central meridian, and for the 11-year cycles Nos. 17 and 18. This also confirms the real existence of stable stages in the evolution of the spot-group area. (auth)

25092 A FEW NOTES ON THE SUNSPOT ACTIVITY IN DEPENDENCE ON THE PHASE OF THE 11-YEAR CYCLE AND ON THE HELIOGRAPHIC LATITUDE. Kopecky, M. (Astronomical Inst., Ondrejov, Czech.); Kuklin, G. V. Bull. Astron. Inst. Czech., 20: 22-9(1969).

The problem of different models of the fine structure of the butterfly diagrams is discussed from the aspect of whether these models express the laws governing the frequency of spot-group formation or the laws governing their importance. It is shown that the double maximum of 11-year cycles, as determined by Gnevyšev (1963), most likely expresses the laws governing the importance of spot groups. Hence, from the existence of the double maximum no conclusion can be drawn on the existence or nonexistence of Spoerer's law, which expresses the law governing the frequency of spot-group formation. (auth)

25093 PHYSICAL PROPERTIES AND DYNAMICS OF INTERPLANETARY DUST. Bandermann, Lothar Wilhelm. College Park, Md., Univ. of Maryland, 1968. 324p.

Thesis.

The physical properties and the distribution of dust in interplanetary space are derived from a study of satellite impact rates, of the zodiacal isophots, and of deep-sea deposits. These data are shown to be self-consistent and compatible with a typically flat size distribution such as given by van de Hulst, for which the mean particle radius is 2.7 microns, the spectral index is p = 2.6, and the dust concentration at 1 AU (in the ecliptic plane) is 5.5×10^{-14} cm^{-3}. It is found that the particles have rather smooth surfaces and that they are stoney and compact. The dust mass per unit volume at 1 AU is equal to 3.4×10^{-21} gm/cm^3, based on the van de Hulst distribution. (TSS)

25094 SOLAR WIND AND ITS INTERACTION WITH PLANETARY BODIES. Alfonso-Faus, Antonio. Minneapolis, Univ. of Minnesota, 1968. 113p.

Thesis.

The problem of the interaction of the solar wind with the Moon is attacked from a kinetic-theory point of view. The boundary conditions are the total absorption of the solar-wind particles by the Moon's surface and the magnetic transparency of the lunar body; these conditions imply the absence of an upstream shock wave. The analytical treatment of the ion component gives the gross features of the structure of the interaction. The main feature is the presence of an empty cavity of conical shape, that has the length of a few tens of Moon radii. This cavity has been observed by the satellite Explorer 35. The inclusion of the electron component represents a refinement to the results obtained from the ion treatment. Two important effects are found due to electron pressure: (a) shortening of the length of the wake and (b) weakening of the gradients of density across the boundary. The two effects are analyzed separately and, in each case, an effective temperature for the ions is defined in order to take into account the presence of the electrons. For a particular value of the electron temperature, the two effective temperatures coincide within ~10%; hence, one can obtain an estimate of the electron temperature in the solar wind by finding the effective temperature that gives agreement between the observations and the predictions of the ion treatment. The drop in density across the boundary of the cavity produces a system of currents that increases the magnetic field strength inside the cavity. The problem is idealized by considering that the drop occurs within a Larmor distance; in this way one arrives at a situation similar to the problem of a solenoid. The present observations show the increase in the magnetic field strength inside the cavity. They also show a decrease across the boundary and an increase just outside the cavity; further refinements to the theory may explain these observations, or they may be the result of a contribution from a weak magnetic field, intrinsic to the Moon, that has been distorted by the solar wind. (Disser. Abstr.)

25095 DIRECT OBSERVATIONS OF SOLAR-WIND PARTICLES. Hundhausen, A. J. (Los Alamos Scientific Lab., N. Mex.). Space Sci. Rev., 8: 690-749(Dec. 1968).

Direct observations of solar-wind particles are discussed in detail. A well-defined "quiet state" of the solar wind is indicated by observations made from 1962 to 1967. The plasma properties in this quiet state are compared with those predicted by hydrodynamic models of the coronal expansion. While the basic flow parameters are predicted with reasonable accuracy by these models, the thermal properties of the solar-wind particles remain largely unexplained. As the interplanetary plasma is not in thermodynamic equilibrium, the thermal properties are determined by the specific energy-transfer mechanisms operative in the plasma. The observed magnitude of the magnetic-field-aligned anisotropy of proton random motions is interpreted as evidence for the presence of instability-generated waves; the effect of these waves on the thermal properties is examined. The observed chemical composition of the solar wind is discussed and related to the solar origin of the interplanetary material. Finally, the spatial and temporal structure of the medium is investigated through consideration of patterns of variation in the plasma properties. (auth)

25096 REDUCED SHOCK RELATIONS IN MAGNETOHYDRODYNAMICS. Wilkerson, T. D. (Univ. of Maryland, College Park). Solar Phys., 6: 44-8(Jan. 1969).

Three of the well-known "jump conditions" across hydromagnetic shock waves are reduced to identities for density, vector velocity, and scalar speed in terms of the vector magnetic field.

Scalar pressure and ion and electron temperature are not made use of. For thermal equilibrium plasmas, these relations may be useful even when no information as to thermal state or degrees of freedom is available. In addition the reduced shock relations may be valid in many nonequilibrium situations. Plasma and field measurements necessary for validating these relations are gradually becoming routine in both laboratory and space experiments. (auth)

25097 CALCULATION OF TRANSITION PROBABILITIES FOR VARIOUS EXCITED STATES OF Fe XII. Rozelot, J.-P. (Observatoire du Pic-du-Midi, Bagneres de Bigorre, France). Solar Phys., 6: 49-55(Jan. 1969). (In French).

The transition probabilities for the forbidden and allowed lines between the $3p^23d-3p^3$, $3p^24s-3p^3$, $3s3p^4-3s^23p^3$, and $3p^24d-3p^3$ states of Fe XII were calculated. The $^2D_{\frac{5}{2}}$, $^2D_{\frac{3}{2}}$, $^2P_{\frac{3}{2}}$, and $^2P_{\frac{1}{2}}$ energy levels were obtained by extrapolation along the P1 isoelectronic sequence. The effects of a deviation in the L-S coupling conditions due to the spin-orbit and configuration interactions are briefly discussed. (tr-auth)

25098 SOLAR LIMB BRIGHTENING AND ENHANCEMENT MEASUREMENTS AT 1.2 MM. Newstead, R. A. (Queen Mary Coll., London). Solar Phys., 6: 56-66(Jan. 1969).

Solar intensity measurements at a mean wavelength of 1.2 mm were made using a 1.6-m Cassegrain telescope. The measurements included a series of scans made during the partial solar eclipse of May 20, 1966. A high degree of solar limb brightening is inferred from the measured intensity distribution. The ratio of the disk-averaged brightness temperature to the central brightness temperature at 1.2 mm is calculated to be 1.11 ± 0.02. A fairly intense solar outburst, of approximate duration 50 min, was observed towards the end of the eclipse. (auth)

25099 MAGNETIC KNOTS NEAR A SUNSPOT. Grigor'ev, V. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Irkutsk, USSR). Solar Phys., 6: 67-71(Jan. 1969).

Observations of longitudinal and transversal fields and of radial velocities in the magnetic "knots" close to a sunspot were made with the help of Sayan Observatory magnetograph with spatial resolution 1.″2 × 1.″8. The analysis led to following conclusions: (1) The magnetic field in the knots is mainly vertical. The mean inclination of the magnetic-field vector to the vertical direction is equal to 26°. (2) The phenomenon of darkening is connected with essentially vertical fields and brightening in the faculae with the horizontal fields on the Sun. (3) An inverse relation between the value of darkening and the inclination of the field vector to the vertical direction and a direct relation on the longitudinal magnetic-field strength exist for the magnetic knots. (4) The magnetic knots in the active region are located in the Hα flocculi near the line where the radial velocity is changing sign in the photosphere. (auth)

25100 OSCILLATORY PHENOMENA IN QUIESCENT PROMINENCES. Kleczek, J.; Kuperus, M. (Univ. Observatory Sonnenborgh, Utrecht). Solar Phys., 6: 72-9(Jan. 1969).

A model for horizontal oscillations of prominences is presented. It is found that the model of a freely oscillating prominence surrounded by coronal matter explains satisfactorily the observed periods and damping times, as well as the changes in the prominence shape. (auth)

25101 THREE-DIMENSIONAL INFORMATION PICTURES OF CHROMOSPHERIC SPICULES. Mamedov, S. G.; Orudzhev, E. Sh. (Shemacha Astrophysical Observatory, USSR). Solar Phys., 6: 41-3(Jan. 1969).

When a cinema-film is taken of the spectral changes over the disk with a slowly moving image of the Sun on the slit, one has a real possibility of obtaining three-dimensional information: two space dimensions and one wavelength dimension. This method is applied to the chromospheric Hα line. (W.D.M.)

25102 POWER SPECTRA OF Hα DOPPLER SHIFTS. Elliott, Ian (Sacramento Peak Observatory, Sunspot, N. Mex.). Solar Phys., 6: 28-40(Jan. 1969).

The temporal characteristics of the chromospheric velocity field in a quiet region were studied by means of a carefully guided sequence of 215 Hα spectra of the disk center lasting 54 min. The Doppler shifts of each frame at $\Delta\lambda = 0.4$ Å were measured and the velocity history of each position on the Sun was reconstructed. The velocity power spectrum was found for each of 256 points along the total slit length of 280,000 km. A steady downward velocity is associated with places where the amplitude of the fluctuating velocity is high. The average velocity power spectrum exhibits three main features: (1) A peak at 287 sec, (2) A group of high frequency peaks in the range 150 to 210 sec, and (3) A low frequency peak with a period of 900 sec. The relationship of these features to the Ca K network is discussed. (auth)

25103 EFFECT OF SHORT-PERIODIC OSCILLATIONS IN THE PHOTOSPHERE ON THE SPECTRAL LINE PROFILE. Teplitskaya, R. B. (Inst. of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Irkutsk, USSR). Solar Phys., 6: 18-27(Jan. 1969).

It is shown that if short-periodic acoustic waves are propagating through the photosphere they influence spectral line profiles considerably. (auth)

25104 INHOMOGENEITIES IN THE SOLAR PHOTOSPHERE. Margrave, Thomas E. Jr.; Swihart, Thomas L. (Univ. of Arizona, Tucson). Solar Phys., 6: 12-17(Jan. 1969).

A model of the solar photosphere incorporating a simple two-stream representation of granulation is found to give a small but significant improvement in the continuous radiation field over a homogeneous model. It is common to assume that the pressure does not vary with horizontal position; however, this assumption cannot be valid if the material is in hydrostatic equilibrium, so horizontal pressure differences between the hot and cold columns are allowed. This has a major effect on the structure, and one of the consequences is that temperature fluctuations at equal optical depths are greater than those at equal geometric depths. (auth)

25105 PLASMA PHYSICS IN SPACE RESEARCH. Obayashi, Tatsuzo (Tokyo Univ.). Inst. Space Aeronaut. Sci., Univ. Tokyo Rep. No. 431, 439-58(Nov. 1968).

Some recent achievements in space research that are closely linked with the field of plasma physics are reviewed. Three topics in particular are discussed, including the solar plasma wind, the collision-free bow shock formed in the sunward fringe of the planetary atmosphere, and convective motions of plasma in the magnetosphere. How hydromagnetic behavior of space plasma is of interest to modern fluid dynamics is discussed. Turbulences and various plasma waves observed in space provide new important problems pertinent to the advanced study of plasma physics. The natural phenomena occurring in the space around the earth are related to fundamental problems of plasma physics, such as the interaction between plasma and magnetic field in ionized gases and energy transport and exchange processes by electromagnetic waves and particles. (BBB)

25106 "BARTELS' ACTIVE LONGITUDES", SECTOR BOUNDARIES, AND FLARE ACTIVITY. Bumba, V.; Obridko, V. N. (Astronomical Inst., Ondrejov, Czech.). Solar Phys., 6: 104-10(Jan. 1969).

The flare activity and especially the proton-flare activity is concentrated in the zones of "Bartels' active longitudes" and in the neighborhood closest to the sector boundaries of the interplanetary magnetic field. This concentration seems to be greater if the importance of the event increases. (auth)

25107 ELECTRONS AND PROTONS IN LONG-LIVED STREAMS OF ENERGETIC SOLAR PARTICLES. Anderson, K. A. (Univ. of California, Berkeley). Solar Phys., 6: 111-32(Jan. 1969).

In 1966 and 1967 many long-lived streams of low-energy solar electrons and protons were observed near Earth. These streams were sometimes associated with bright flares which occurred many hours earlier and sometimes no individual flare could be found. In the latter case the particles are evidently to be associated in a general way with solar active centers as Fan et al., (1968) have done. The long-lived solar events discussed here include energetic storm particles, delayed events, and fluxes associated with solar active regions. It is suggested here that these are all probably the same basic phenomena viewed in somewhat different ways depending on the age of the region and its location on the solar disc. These events are usually associated with a depression in the sea-level neutron intensity and one or more sudden commencements of sudden impulses. Both electrons and protons are present in these events but in several cases electrons were not detected. The most unusual feature is that when both particle species are present, the electron flux is centered several hours before the proton flux. (auth)

25108 INTERPRETATION OF TIME CHARACTERISTICS OF SOLAR X-RAY BURSTS REFERRING TO ASSOCIATED MICROWAVE BURSTS. Takakura, Tatsuo (Tokyo Univ.). Solar Phys., 6: 133-50(Jan. 1969).

It has been controversial whether the flare-associated hard x-ray bursts are thermal emission or nonthermal emission. Another controversial point is whether or not the associated microwave impulsive burst originates from the common elec-

trons emitting the hard x-ray burst. It is shown that both the thermal and nonthermal bremsstrahlung should be taken into account in the quantitative explanation of the time characteristics of the hard x-ray bursts observed so far in the photon energy range of 10 to 50 keV. It is emphasized that the nonthermal electrons emitting the hard x rays and those emitting the microwave impulsive burst are not common. The model is as follows, which is also consistent with the radio observations. At the explosive phase of the flare a hot coronal condensation is made, its temperature is generally 10^7 to $10^{8.5}$K, the number density is about 10^{10} cm^{-3} and the total volume is of the order 10^{29} cm^3. A small fraction, 10^{-3} to 10^{-4}, of the thermal electrons is accelerated to have power law distribution. Both the nonthermal and thermal electrons in the sporadic condensation contribute to the x-ray bursts above 10 keV as the bremsstrahlung. Fast decay of the harder x rays (say, above 20 keV) for a few minutes is attributed to the decay of nonthermal electrons due to collisions with thermal electrons in the hot condensation. Slower decay of the softer x rays including those around 10 keV is attributed to the contribution of thermal component. (auth)

25109 ATLAS OF 10 TO 50 keV SOLAR FLARE X-RAYS AND TENTATIVE ATLAS OF SOLAR PROTON EVENTS OBSERVED BY THE OGO-I AND OGO-III IONIZATION CHAMBERS. Kane, S. R.; Winckler, J. R. (Univ. of Minnesota, Minneapolis). Solar Phys., 6: 151(Jan. 1969).

The availability of technical reports issued by the Space Physics Group of the University of Minnesota summarizing energetic solar-flare x rays and possibly solar-particle events beginning with September 1964 and extending to the present time is announced. The atlas is briefly described. (W.D.M.)

25110 RELATION BETWEEN SUNSPOT AREA CHANGES AND FLARE OCCURRENCES. Sivaraman, K. R. (Kodaikanal Observatory, India). Solar Phys., 6: 152-4(Jan. 1969).

Howard (1963) examined the areas of spot groups associated with six major solar flares, one day prior, to one day after the flare, and attributed the decrease in area of the spot group in each case as caused by the flare. The relation is examined closely here by extending it to a few other spot groups in which major solar flares have occurred. A brief reply by Howard is included. (W.D.M.)

25111 FORBIDDEN SULPHUR I LINES IN THE SOLAR SPECTRUM. Swings, J. P. (Univ., Liege); Lambert, D. L.; Grevesse, N. Solar Phys., 6: 3-11(Jan. 1969).

The S I lines are due to transitions within the $3s^23p^4$ ground configuration of neutral sulphur. The results are presented from a search for the S I lines in the Fraunhofer spectrum. Two identifications are proposed with faint features in the Fraunhofer spectrum: $^1D_2-S_0$ at 7725.02 Å and $^3P_2-^1D_2$ at 10821.23 Å. Their measured equivalent widths are shown to confirm the value for the solar abundance of sulphur, log N_s = 7.21 (in the scale log N_H = 12.00), which is derived from the permitted high-excitation lines. These lines give the first convincing identification of S I lines in an astrophysical source. (auth)

25112 INITIAL DEVELOPMENT OF SOLAR FLARES. Vesecky, J. F.; Meadows, A. J. (Univ. of Leicester, Eng.). Solar Phys., 6: 80-5(Jan. 1969).

The extent to which the early phases of solar-flare development can be accounted for by a simple high-temperature chromospheric explosion model is investigated without involving a particular energy source. A model is developed in which it is shown that a point explosion in the lower chromosphere can be treated as a virtually instantaneous release of energy throughout a volume of radius R ≈ 100 km, which subsequently expands as a classical hydrodynamic blast wave in which $R \sim (\alpha < \frac{2}{5})$. This model is in substantial agreement with areal growth-rate observations of disk flares. An explanation for the fact that limb-flare observations can imply $\alpha > \frac{2}{5}$ is suggested by considering the effects of the large atmospheric density gradient in the lower chromosphere on an upward traveling shock wave. (auth)

25113 SOLAR FLARES OF AUGUST 28 AND 30, 1966. Zirin, Harold; Lackner, D. Russo (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Solar Phys., 6: 86-103(Jan. 1969).

Observations of the class 3+ flare of August 28, 1966, made at the Mount Wilson Observatory, are described. This great proton flare followed the sequence: (1) precursor flare; (2) filament eruption; (3) beginning in penumbra of large spot; (4) rapid elongation in two strands; (5) great spray and surface wave; (6) rapid separation of two strands to maximum brightness; and (7) slow spread of brightness and decay. The soft x-ray burst coincides with stages 3–6, decaying through stage 7; the hard (>80 keV) burst coincides, but decays more rapidly. Considering a demicylinder of emitting material, the soft x rays are explained by a 4-million-degree plasma, or at least a large flux of electrons with that amount of energy. Given this flux, the microwave burst is explained by synchrotron emission with the low frequency cutoff due to coronal absorption. The class-2 flare of August 30, 1966, is also discussed. (auth)

25114 DISCUSSION OF PAPER BY C. Y. FAN, M. PICK, R. PYLE, J. A. SIMPSON, AND D. R. SMITH, "PROTONS ASSOCIATED WITH CENTERS OF SOLAR ACTIVITY AND THEIR PROPAGATION IN INTERPLANETARY MAGNETIC FIELD REGIONS COROTATING WITH THE SUN". Wilcox, John M.; Schatten, Kenneth H. (Univ. of California, Berkeley). J. Geophys. Res., 74: 2449-51(May 1, 1969).

A recent paper by Zan, et. al., (1968) discussed energetic protons associated with centers of activity and their propagation in interplanetary magnetic-field regions corotating with the Sun. Observations and analysis subsequent to this paper make possible a further discussion of this subject. (W.D.M.)

25115 INTERPLANETARY SECTOR STRUCTURE IN THE RISING PORTION OF THE SUNSPOT CYCLE. Wilcox, John M. (Univ. of California, Berkeley); Colburn, David S. J. Geophys. Res., 74: 2388-92(May 1, 1969).

The interplanetary sector structure during the rising portion of the sunspot cycle in 1966 and 1967 was investigated. The sector pattern is often quasi stationary for a few rotations, followed by an appreciable change in the next rotation. When a sector boundary passes the Earth, geomagnetic activity tends to increase, an effect rather similar to that observed near sunspot minimum. The recurrence period of the interplanetary field during the interval investigated was 27.5 ± 0.1 days. (auth)

25116 FURTHER EVIDENCE ON THE CORRELATION BETWEEN TRANSVERSE FLUCTUATIONS IN THE INTERPLANETARY MAGNETIC FIELD AND Kp. Ballif, J. R. (Brigham Young Univ., Provo, Utah); Jones, D. E.; Coleman, P. J. Jr. J. Geophys. Res., 74: 2289-2301(May 1, 1969).

The correlations between the Kp index and solar-wind variables measured during the flights of Mariners 2, 4, and 5 are discussed. It is shown that during the time of these flights, Kp is highly correlated with $\sigma B_{T,N}$, a measure of the interplanetary magnetic field fluctuations. It is better correlated with this quantity than it is with either the interplanetary magnetic field strength or the plasma speed. The typical, large-scale structure of events in the solar wind that occur in conjunction with major geomagnetic activity is also discussed. (auth)

25117 LARGE-AMPLITUDE ALFVEN WAVES IN THE INTERPLANETARY MEDIUM: MARINER 5. Belcher, J. W. (California Inst. of Tech., Pasadena); Davis, Leverett Jr.; Smith, E. J. J. Geophys. Res., 74: 2302-8(May 1, 1969).

Correlation coefficients greater than 0.8 in absolute value between the radial components of the interplanetary magnetic field and the solar-wind velocity are found at least 30% of the time in five months of data from Mariner 5 (Venus 1967). They can best be explained as due to large-amplitude, aperiodic Alfvén waves propagating outward from the Sun along the average magnetic field direction. The magnetic fluctuations on such occasions are predominantly normal to the average field direction, have characteristic times of the general order of one hour, and the fluctuations in density are relatively small. (auth)

Galaxies

25118 INFLUENCE OF A SHOCK WAVE ON THE IONIZATION OF GAS IN A CLUSTER OF GALAXIES. Yankulova, I. M. (Shternberg State Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 765-7(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 962-5(Sept.-Oct. 1968).

The manner in which shock waves arising from the movement of galaxies within clusters affect the degree of ionization of intergalactic gas is discussed in the present article. It is shown that ionization produced by these shock waves cannot be neglected in the case of very dense clusters. (auth)

25119 THE COMETARY NEBULAE SIMEIZ 129 AND 130. Dibai, E. A. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 768-72(Mar.-Apr. 1969).

Translated from Astron. Zh., 45: 966-72(Sept.-Oct. 1968).

The comet-shaped nebulae Simeiz 129, (the "Lizard") and Simeiz 130, (the "Fireball") were investigated on photographs taken with the 125 cm reflector. The absolute intensity of the Hα line yielded the electron density in the tails of the nebulae ($n_e \approx 200$ cm^{-3} for S129, 100 cm^{-3} for S130) and in the emission rims at the boundary of the heads ($n_e \approx 250$ cm^{-3} for S129, 200

cm^{-3} for S130). The mass was estimated for the tails (≈0.1 to 0.2 $M_\odot$) and heads (≈10 to 30 $M_\odot$) of S129 and S130. It is suggested that the observed characteristics of the two objects may be explained by a mechanism of shock-wave focusing that results in the ejection of a stream of gas traveling through an external magnetic field. (auth)

25120 DUST MATERIAL IN THE ANDROMEDA NEBULA. Sharov, A. S. (Shternberg Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.), 12: 779-82(Mar.-Apr. 1969).
Translated from Astron. Zh., 45: 980-4(Sept.-Oct. 1968).
The distribution of absorbing material in the Andromeda Nebula is considered. On the average the absorption remains practically constant out to 80′ from the center. The optical half-thicknesses of the absorbing layer perpendicular to the plane of the Nebula is about 0.3 m in visual light. (auth)

25121 RELAXATION TIME OF ROTATING STELLAR SYSTEMS. Genkin, I. L. (Astrophysical Inst., Alma-Ata, USSR). Sov. Astron. AJ (Engl. Transl.), 12: 858-62(Mar.-Apr. 1969).
Translated from Astron. Zh., 45: 1085-90(Sept.-Oct. 1968).
When resonance effects are taken into account, the estimates for the relaxation time in stellar systems are diminished by two or three orders of magnitude. If allowance is also made for the influence of star clouds, clusters, and the like, a final estimate of $\tau = 10^9$ to 10^{10} yr is obtained for the relaxation time. The problem of the disintegration of a star cluster through the action of perturbations by background stars is discussed. (auth)

25122 THE STRUCTURE AND EVOLUTION OF GALAXIES. Proceedings of the Thirteenth Conference on Physics at the University of Brussels, September 1964. New York, Interscience Publishers, 1965. 181p. (CONF-640934).
Papers are presented on nuclei of galaxies and their activity, structure and evolution of galaxies, magnetic fields and cosmic rays, formation of stars, stellar evolution, supernovae, supernova remnants, extragalactic radio sources, spectroscopic observations of extragalactic radio sources, and mechanisms of extragalactic radio sources. Brief discussions are given with each paper. (W.D.M.)

25123 EVIDENCE OF LIGHT VARIATION IN NGC 1275. Peterson, B. A. (California Inst. of Tech., Pasadena). Contract Nonr-220(47). Astrophys. Lett., 3: 103-5(Apr. 1969).
Photoelectric observations of the Seyfert galaxy NGC 1275 indicate that the nucleus of the galaxy has brightened by 0.5 magnitudes in the interval January 1967 to November 1968. (auth)

25124 ANISOTROPIC GALACTIC EMISSIONS AT LYMAN ALPHA AND NEARBY WAVELENGTHS. Tinsley, Brian A. (Southwest Center for Advanced Studies, Dallas). J. Geophys. Res., 74: 2327-32(May 1, 1969).
The isophotes of Lyman-α emission in the night sky interpreted by Kondo and Kupperian as being due to collisional excitation of hydrogen in the upper atmosphere are explained in terms of emission at Lyman α or elsewhere in the band 1040 to 1225 A, from sources situated near the plane of the Galaxy, superimposed on the Lyman α resulting from multiple scattering of Lyman α in the geocorona. If the galactic anisotropic radiation is Lyman α, there are implications concerning the interstellar medium near the Sun. (auth)

Cosmology

Refer also to abstract 25838.

25125 INTERPRETATION OF COORDINATES IN THE SCHWARZSCHILD PROBLEM. Brumberg, V. A. (Inst. of Theoretical Astronomy, Leningrad). Sov. Astron. AJ (Engl. Transl.), 12: 879-81(Mar.-Apr. 1969).
Translated from Astron. Zh., 45: 1110-13(Sept.-Oct. 1968).
The Infeld–Plebansky method is used to project the space of events in the Schwarzschild problem in various coordinate systems upon a Galilean system at infinity by means of light rays. The Painlevé coordinates corresponding to a central force field are found to experience the minimum distortion in this mapping. (auth)

25126 MODEL OF THE EXPANDING UNIVERSE. Wataghin, G. (Univ., Turin). Nuovo Cim., Lett., 1: 375-8(Mar. 1, 1969).
The purpose of this note is to establish some new properties of the Friedman solution of the Einstein equations for the expanding or oscillating Universe. (W.D.M.)

25127 WAVELENGTH INDEPENDENCE OF THE VELOCITY OF LIGHT IN SPACE. Warner, B.; Nather, R. E. (Univ. of Texas, Austin). Nature (London), 222: 157-8(Apr. 12, 1969).
It is stated that in view of the great distances involved, time measurements on astronomical events afford the best possibility for a high precision determination of the relative velocities of electromagnetic radiation at different wavelengths. In this connection studies are described on the detection of optical pulses from the Crab Nebula pulsar, using the 82-in. Struve reflector at the McDonald Observatory, leading to the conclusion that there is no evidence for a wavelength dependence of the velocity of light. (UK)

25128 POPULATION II STAR MODELS AND ABUNDANCE OF PRIMAEVAL HELIUM. Castellani, V. (Astrophysical Lab., Rome); Giannone, P.; Renzini, A. Nature (London), 222: 151-3(Apr. 12, 1969).
It is stated that since the discovery of the 3°K cosmic black-body radiation the hypothesis of He formation in a primordial fireball has received some support. A value of $Y \simeq 0.25$ for the abundance of He, by mass, synthesised in a hot "big-bang" was deduced by Fowler and Hoyle, and if this value were found in the oldest stars of the Galaxy, that is, in the extreme population II stars of globular clusters, the "big-bang" cosmological model would receive further strong support. An alternative to the unreliable spectroscopic determination of the He abundance in these stars is an approach from the theory of stellar evolution; in this paper some of the discouraging problems involved in this approach are discussed. (UK)

25129 TWO-COMPONENT PICTURE OF FERMION TRAJECTORY AND COSMOLOGICAL ORIGIN OF ZITTERBEWEGUNG. Hokkyo, Noboru (Hitachi Central Research Lab., Kawasaki, Japan). Progr. Theor. Phys. (Kyoto), 40: 1439-45 (Dec. 1968).
A previous space-time picture of elementary particles, in which the particle mass arises from the particle trajectory with changing time direction or Zitterbewegung, is reconsidered from the viewpoint of the two-component fermion theory, and the origin of Zitterbewegung is sought in the fluctuating metric of cosmological origin. Since the universe is supposed to have its beginning within a very small spatial region, a possible alteration, brought about by our space-time picture, of the notion of mass in regions smaller than the Compton wavelength is also discussed. (auth)

Planetary Phenomena

25130 RELATION BETWEEN THE VISIBILITY OF JUPITER'S RED SPOT AND SOLAR ACTIVITY. Basu, D. (National Research Council, Ottawa). Nature (London), 222: 69-70(Apr. 5, 1969).
The claim of dependence of the red spot on uv radiation from the Sun (Graf et al., Nature 218: 857 (1968)) was subsequently discarded (Argyle, Nature 219: 474 (1968)) on the basis of a very low value of the correlation coefficient between the visibility (V) and the Zurich relative sunspot number. Since the sunspot is regarded as the index of both wave and particle radiations from the Sun, re-investigation of the relationship with available sunspot data was considered worthwhile by the present author. The lack of correlation in Graf's data appears to be due to the presence of some irregular fluctuations in the visibility function; these fluctuations were removed in the present analysis. A striking feature of the revised data is the close correspondence between the two phenomena over the period 1894 to 1945. A significant correlation is obtained, indicating that the variation of the visibility of the red spot does have a component, dependent on solar activity. Subsequent values of V, however, show a completely different correspondence which does not fit the previous period, and the correlation coefficient for the period 1894 to 1965 is much reduced. The apparent discontinuity around 1947 raises problems of inconsistency; this is also the time when there was an expected large enhancement in sunspot numbers. It is suggested that it might be worthwhile to investigate whether the two phenomena might have a common cause external to both, such as local variation in density of the interstellar medium. (UK)

Atomic and Molecular Physics

Refer also to abstracts 24270, 25030, 25084, 25283, 25344, 25464, 25743, and 25769.

25131 (BMwF-FBK-69-3, pp 21,1-13) KINETIC THEORY OF THE ENERGY SPREAD IN ELECTRON BEAMS. Fischer, M. (Marburg Univ. (West Germany). Institut fuer Theoretische Physik).
The Vlasov equation for the electrons is used to show that the anomalous energy spread in electron beams is due to thermal noise. The kinetic equation is solved to second order in a parameter which is equal to the quotient of thermal velocity over

drift velocity. In this way the nonlinearity of the kinetic equation can be retained, giving better values for the correlation functions than those obtainable from a linearized theory. (auth)

25132 (IFA-FT-74) COMPTON SCATTERING OF PHOTONS BY BOUND K-SHELL ELECTRONS. Gavrila, M. (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). Mar. 1969. 10p. Dep.

The nonrelativistic matrix element for Compton scattering by bound K-shell electrons, with retardation included, is evaluated analytically exactly in terms of hypergeometric functions of Lauricella's type F_D. This is done by expressing the matrix element with the help of the Coulomb Green's function in momentum space, for which the integral representation of Schwinger is used. In the dipole approximation the matrix element reduces to essentially three hypergeometric Appell functions F_1. (auth)

25133 (LA-4079) COMPTON SCATTERING FACTORS FOR ASPHERICAL FREE ATOMS. Cromer, Don T. (Los Alamos Scientific Lab., N. Mex.). Mar. 17, 1969. Contract W-7405-eng-36. 242p. Dep. CFSTI.

Incoherent scattering factors for all aspherical free atoms have been computed from numerical SCF Hartree–Fock wave functions. The complete Waller–Hartree theory with all exchange terms has been used. (auth)

25134 (ORNL-4393) EIGENVALUES FOR ELEMENTS FROM Z = 2 TO 103 IN A GOOD APPROXIMATION TO RELATIVISTIC HARTREE–FOCK SOLUTIONS. Carlson, Thomas A.; Pullen, B. P. (Oak Ridge National Lab., Tenn.). Apr. 1969. Contract W-7405-eng-26. 31p. Dep. CFSTI.

Eigenvalues have been calculated for all the shells of all the elements from Z = 2 to 103 in their ground states as free atoms. These values should be in good agreement with those computed from relativistic Hartree–Fock solutions. The values presented have been obtained by determining a relativistic correction as developed from self-consistent field calculations, both nonrelativistic and relativistic, in which exchange has been approximated in an identical fashion. Eigenvalues from nonrelativistic Hartree–Fock solutions are then multiplied by this relativistic correction to obtain the desired result. Comparison of the approximate eigenvalues with those calculated directly from relativistic Hartree–Fock solutions shows excellent agreement. (auth)

25135 (UCRL-18654) PIONIC ATOMS. Kunselman, Arthur Raymond (California Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1969. 84p. Dep. CFSTI.

Thesis.

The x rays produced by negative pions stopped in various targets were measured. The line shifts, line widths, and line intensities in pure element targets were measured to observe the effect of the pion–nuclear strong interaction. An optical-model analysis for the shifts and widths is presented. The line intensities in chemical-compound targets were measured to observe the effects of the chemical composition of the target on the probability of pion capture by the constituents. Germanium solid-state detectors were used throughout. (auth)

25136 (UCRL-50602) POPULATION DISTRIBUTIONS. II. CHARGE EXCHANGE CAPTURE BY PROTONS INCIDENT UPON GROUND STATE ATOMS. Hiskes, John R. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 7, 1969. 27p. Dep. CFSTI.

The ratios of the excited captures to the total captures have been computed for charge-exchange collisions of protons incident upon each of the elements in its ground state. The calculations have been performed for incident proton energies of 5 to 140 keV; a simplified form of the Brinkman–Kramers matrix element was employed. Generally speaking the extremes of behavior of the population distributions occur for charge-exchange collisions with the alkali metals and with the inert gases; the population distributions for the other target elements fall smoothly within these extremes. The main variations of the population ratios and the primary trends for different target elements agree reasonably well with available experimental data. (auth)

25137 INTERACTION BETWEEN A NEUTRAL ATOMIC OR MOLECULAR BEAM AND A CONDUCTING SURFACE. Raskin, D.; Kusch, P. (Columbia Univ., New York). Contract DA-28-043 AMC-00099(E). Phys. Rev., 179: 712-21(Mar. 15, 1969).

The deflection of a beam of neutral atoms by an uncharged conducting surface has been observed. This deflection is a result of the attraction between the instantaneous electric dipole moment of an atom in the beam and the image dipole induced in the metal. The measured deflections agree in form and magnitude with those predicted from theoretical interaction potentials. Changes in the geometry of the deflecting surface give results in agreement with predictions. The deflection of a beam of polar molecules by metal and dielectric surfaces has also been observed. It can be explained by the interaction between the surface and the total instantaneous electric dipole moment of the molecule, including one characterized by motion at the frequency of molecular rotation, and one by motion at electronic frequencies. (auth)

25138 MULTIPLE SCATTERING IN THE KAPITZA–DIRAC EFFECT. Schappert, G. T. (Electronics Research Center, Cambridge, Mass.). Phys. Lett., 29A: 6-7(Mar. 24, 1969).

A simple multiple scattering approach to the Kapitza–Dirac effect leads to two coupled rate equations and results in a transition probability less than unity. (auth)

25139 COMMENTS ON "OBSERVATION OF LAMB SHIFTS BY QUANTUM BEATS." Series, G. W. (Oxford Univ.). Phys. Rev., 178: 429-30(Feb. 5, 1969).

Recently, Hadeishi [(Phys. Rev. Lett., 21: 957(1968)] reported an observation of an S–P level crossing in He^+ in an experiment based on modulated excitation of the ions. He referred to his observations as manifestations of "quantum beats." It is pointed out here that the effect observed is related to the differential damping of excited levels and is to be distinguished from "beat" phenomena. (A.G.W.)

25140 CROSS SECTIONS FOR ION AND ELECTRON PRODUCTION IN GASES BY 0.15- TO 1.00-MeV HYDROGEN AND HELIUM IONS AND ATOMS. Puckett, L. J.; Taylor, G. O.; Martin, D. W. (Georgia Inst. of Tech., Atlanta). Phys. Rev., 178: 271-87(Feb. 5, 1969).

Measurements of absolute total apparent cross sections for processes leading to slow-electron and ion production in the gases He, Ar, H_2, and N_2 by incident beams of He^{++}, He^0, and H^0 in the energy range 0.15 to 1.00 MeV are reported. From these measurements absolute total apparent cross sections for ionization, electron capture, and stripping were deduced. The present results are compared with those from other experiments and with available theoretical calculations. (auth)

25141 CHARGE PRODUCTION IN COLLISIONS BETWEEN HYDROGEN ATOMS, AND He, Ne, Ar, AND H_2 IN THE ENERGY RANGE FROM 50 TO 1000 eV. Fleischmann, Hans H. (Cornell Univ., Ithaca, N. Y.); Young, Robin A. Phys. Rev., 178: 254-60(Feb. 5, 1969).

Experimental results on negative-charge production in collisions of hydrogen atoms with He, Ne, Ar, and H_2 are reported. For the three noble gases a rather smooth rise of the cross section with energy was found, absolute values ranging from about 10^{-18} to 10^{-16} cm^2. For collisions of H on H_2, an interesting structure appears, which seems to extend structure indicated in earlier high-energy measurements. From extrapolations of our results and comparison with high-energy stripping measurements, a trend in the ratio between target ionization and projectile stripping from He to Ne to Ar is indicated. (auth)

25142 ELECTRON-TRANSFER CROSS SECTIONS OF 5- TO 70-keV HYDROGEN ATOMS AND IONS IN MAGNESIUM VAPOR. Berkner, Klaus H.; Pyle, Robert V.; Stearns, J. Warren (Univ. of California, Berkeley). Phys. Rev., 178: 248-53(Feb. 5, 1969).

Experimental electron-capture and -loss cross sections of 5- to 70-keV hydrogen atoms and ions in magnesium vapor are reported for the processes $H^+ \rightarrow H^0$, $H^0 \rightarrow H^+$, $H^0 \rightarrow H^-$, and $H^- \rightarrow H^0$. The cross sections for these processes are compared with measurements by other groups. Results for the $H^+ \rightarrow H^0$ capture process in magnesium are compared with the semiclassical formulation by Bates and Mapleton and with Born-approximation [Brinkman–Kramers (BK)] calculations by Hiskes adjusted according to prescriptions by Mapleton and Nikolaev. The adjusted BK capture cross sections are in satisfactory agreement with the measurements. (auth)

25143 NORMALIZATION OF CROSS SECTIONS FOR CHARGE-TRANSFER COLLISIONS PRODUCING METASTABLE (2S) HYDROGEN ATOMS. Gaily, T. Dean (Univ. of Washington, Seattle). Phys. Rev., 178: 207-9(Feb. 5, 1969).

Reported measurements of the cross section for the production of metastable hydrogen atoms in the 2S state are compared to theoretical predictions for charge-transfer collisions between protons and helium and atomic hydrogen. The magnitudes of the cross sections for some of the experimental data are arbitrarily adjusted to produce a consistent energy dependence of the reaction cross sections. Agreement between recent theoretical predictions and experiment is then found to be excellent, leading to the conclusion that for these excited-state charge-transfer reactions, the Born approximation is not a valid description, even at projectile energies above 100 keV. (auth)

25144 REDUCED COULOMB GREEN'S FUNCTION FOR BOUND-STATE CALCULATIONS. Hostler, Levere C. (Wilkes

Coll., Wilkes-Barre, Pa.). Phys. Rev., 178: 126-31(Feb. 5, 1969).

The known closed-form expression for the coordinate space Coulomb Green's function is specialized for applications involving perturbations of the ground state of the hydrogen atom by removing the ground-state pole term and evaluating the finite part at the pole. The resulting closed-form expression is simpler than the full Green's function and may be quite useful. (auth)

25145 EXACT TREATMENT OF THE STARK EFFECT IN ATOMIC HYDROGEN. Alexander, Millard H. (Harvard Univ., Cambridge, Mass.). Phys. Rev., 178: 34-40(Feb. 5, 1969).

A boundary-condition method is used to investigate the energy levels of atomic hydrogen in a uniform electric field. At low fields the misbehavior of trial eigensolutions in the nonclassical region enables one to obtain high-accuracy upper and lower bounds to the Stark shift. At higher fields the energy levels are treated as resonant states imbedded in a continuum. A modified WKB approach is used to obtain both the position and width of these resonances. Comparison is made with the usual perturbation-theory results. (auth)

25146 MEASUREMENT OF AN EMISSION CROSS SECTION FOR THE COLLISION REACTION $H^+ + N_2(X^1\Sigma_g^+, v = 0) \rightarrow H(3p, 3d) + N_2^+(B^2\Sigma_u^+, v = 0)$ USING PHOTON-COINCIDENCE TECHNIQUES. Young, S. J.; Murray, J. S.; Sheridan, J. R. (Univ. of Alaska, College). Phys. Rev., 178: 40-9(Feb. 5, 1969).

The measurement of the cross section for the emission of a Balmer-α and a $N_2^+(0,0)$ first-negative-band photon from a hydrogen atom and a N_2^+ molecule excited simultaneously in the same $H^+ + N_2$ electron-capture collision has been performed in the proton-velocity range from 0.54×10^8 to 2.40×10^8 cm/sec. The measurement has been accomplished using the technique of single photon-coincidence detection. To within the random error of the experiment, the cross section has only a single-peak structure with a maximum value of 1.2×10^{-18} cm^2 at a velocity of 1.5×10^8 cm/sec. The magnitude and shape of the measured cross section are found to be in good agreement with a cross section calculated by assuming that final-state excitations of the two product systems are uncorrelated. (auth)

25147 FREQUENCY SHIFTS IN ATOMIC-BEAM EXPERIMENTS. Evans, Leonard (General Motors Research Labs., Warren, Mich.). Phys. Rev., 178: 430-1(Feb. 5, 1969).

In certain triple-loop atomic-beam experiments reported in the literature, a shift in the resonance frequency was observed on reversing the direction of the C field. This shift is explained by assuming that the rf field changes in direction along the transition region, which causes the moving atom to experience a frequency difference from that of the basic oscillatory frequency. All the observed properties of the shift can be accounted for by the explanation given. (auth)

25148 ANALYSIS OF ENERGY DISTRIBUTION OF PARTICLES FROM COLLISION NUMBER FORMULA. Basov, Yu. G.; Panchenkov, G. M.; Lapitskii, A. A. Vestn. Mosk. Univ., Ser. II. Khim., No. 1, 83-6(Jan.-Feb. 1969). (In Russian).

The analysis of the energy distribution of particles by a double-collision-number formula was carried out by means of the Monte Carlo method. (auth)

25149 EMISSION OF AUGER ELECTRONS BY ATOMS OF A METALLIC TARGET SUBJECTED TO IONIC BOMBARDMENT. Hennequin, Jean-Francois (CNRS, Orsay, France). J. Phys. (Paris), 29: 1053-65(Nov.-Dec. 1968). (In French).

The energy distribution of secondary electrons ejected from a metallic target upon bombardment by noble gas ions of a few keV was studied with a magnetic analyzer. It is generally felt that the kinetic emission of secondary electrons results from de-excitation by the Auger effect of "knocked-on" metal particles; the major part of these electrons is slowed down before leaving the target. However, the energy distribution of electrons emitted by some light metals (Be, Mg, Al, Si) shows a peak at an energy characteristic of the bombarded metal; no similar effect appears with heavy metals (Ti, Ni, Cu). The electrons having the energy of this peak are not slowed down and are produced by Auger de-excitations in the vicinity of the surface; a small fraction of these de-excitations occurs outside the metal, with production of secondary positive ions. (auth)

25150 CHEMICAL SHIFTS OF THE $K_{\alpha 1}$ X-RAY LINES DURING OXIDATION OF RARE EARTH METALS. THE ROLE OF f-ELECTRONS. Sumbaev, O. I.; Smirnov, Yu. P.; Petrovich, E. V.; Zykov, V. S.; Egorov, A. I.; Grushko, A. I. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz., 56: 536-40(Feb. 1969). (In Russian).

The energy differences of $K_{\alpha 1}$ x rays are measured for a number of rare-earth metals and their sesquioxides with the purpose of further investigation of the role of electrons with different orbital quantum numbers (s, p, d, f electrons) in the chemical shift effect of the $K_{\alpha 1}$ x ray lines. It is found that, whereas for all trivalent rare earth metals the shifts are approximately the same and relatively small, for divalent Eu and Yb in the metallic state the shifts due to oxidation to Eu_2O_3 and Yb_2O_3 are anomalously large and are negative. The anomalous shifts are interpreted as being due to variation of the number of f-electrons during oxidation of Eu and Yb. The constant C_f is determined and $C_f = -760 \pm 30$ MeV, which is markedly different from the respective values for sp and d electrons: $C_{sp} = +75 \pm 5$ MeV, $C_d = -145 \pm 10$ MeV. This difference indicates that if the effect under consideration is employed as a method for investigation of the valency configuration of chemical bonds it should readily permit a distinction between f electrons and sp and d electrons. (auth)

25151 MUONIUM AND ITS CHEMICAL COMPOUNDS. Szplecki, Jozef. Postepy Fiz., 20: 23-35(1969). (In Polish).

To solve the problem of the μ^+-meson depolarization in interactions with material bodies, the concept of muonium as a hydrogen-like atom (μ^+, e^-) and its possible chemical reactions and compounds with acceptors is discussed. (auth)

25152 ABSOLUTE MEASUREMENT OF THE DIFFERENTIAL BREMSSTRAHLUNG EMISSION CROSS SECTION FOR 120-keV MONOKINETIC ELECTRONS. Quivy, R.; Franeau, J. (Institut Interuniversitaire des Sciences Nucleaires, Mons, Belg.). J. Phys. (Paris), 29: 985-9(Nov.-Dec. 1968). (In French).

An experimental method for measuring the bremsstrahlung differential cross section is described. Experiments were carried out for emission angles from 35° to 155° and for some radiators, the atomic number varying from 13 to 79. The results agree with theory concerning the emission angle of maximum intensity. The differential cross section was found to follow the law: $Z^x f(E_0, \theta, h\nu)$, where $x = 2.27 \pm 0.05$. (auth)

25153 IONIC MICROANALYZER. Slodzian, Georges (Faculte des Sciences, Orsay, France). Rev. Phys. Appl., 3: 360-4(Dec. 1968). (In French).

A method of local analysis based on the emission of characteristic ions from a solid sample bombardment by an ion beam of a few keV is discussed. It is possible either to get a distribution image of one-micron resolution or to perform an analysis in depth with a resolution of 100 Å by a gradual sputtering of the sample. All the elements can be determined. (auth)

25154 PHOTOELECTRIC CROSS-SECTIONS OF 192 keV GAMMA-RAYS IN Ta AND Cd. Raja Rao, M.; Parthasaradhi, K.; Jnanananda, Swami (Andhra Univ., Waltair, India). Curr. Sci. (India), 38: 161-2(Apr. 5, 1969).

Photoelectric cross sections of 192-keV gamma rays are determined by the internal–external conversion technique, using a scintillation spectrometer. The results are found to be in agreement with the available theoretical and compiled data within the range of errors. (auth)

25155 MEASUREMENT OF STARK BROADENING OF Ba II LINES WITH THE AID OF A RADIALLY SYMMETRIC SLIDING DISCHARGE. Jaeger, H. (Univ., Kiel). Z. Phys., 223: 19-31(1969). (In German).

A discharge sliding along the surface of a liquid jet can be used to produce plasmas suited for the determination of atomic constants. Using such a plasma the Stark width of some Ba II lines have been measured. At an electron density of 10^{17} cm^{-3} the half widths agree within 35% with recent calculations made by Cooper and Oertel. (auth)

25156 POLARIZATION OF $3^3D \rightarrow 2^3P$ RADIATION FROM HYDROGEN ATOMS PRODUCED BY FAST-PROTON IMPACT ON He, Ne, H_2, O_2, AND Ar. Hughes, R. H.; Doughty, B. M. (Univ. of Arkansas, Fayetteville). J. Opt. Soc. Amer., 59: 659-60(May 1969).

Polarization of $3^3D \rightarrow 2^3P$ radiation from hydrogen atoms produced by impact of 10- to 35-keV protons on gases was measured. Results are shown for He, Ne, H_2, O_2, and Ar. When averaged over all energies, polarization was approximately +30% for He, slightly less for H_2 and Ne, and +15% to +20% for O_2 and Ar. In general impact on the lighter gases seemed to give a higher polarization. (A.G.W.)

25157 EFFECT OF NEIGHBORING IDENTICAL ATOMS ON RADIATIVE LIFETIME: THE CASE OF THREE ATOMS. Lurie, Joan B. (University Coll., London). J. Chem. Phys., 50: 2325-8(Mar. 15, 1969).

Transition frequencies (inverse radiative lifetime) are evaluated as a function of separation for a system of three identical atoms or molecules one of which is initially excited. The result-

ing frequencies are increased or decreased relative to the value characteristic of an isolated atom according to whether the wave function is symmetric or not. The results depend on the geometrical configuration of the atoms. (auth)

25158 THE BOUNDARY CONDITION TO BE USED IN THE THEORETICAL TREATMENT OF ION–ATOM COLLISIONS. Fennema, J. W. R. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Physica, 39: 13-16(July 1, 1968).

It is a general property of Schroedinger theory to have its (observable) results invariant if a constant with modulus 1 is added to the wave function, which provides the solution. This property is shown to be forfeited if the coupling of a pair of states used to represent the solution is not joined by the corresponding back-coupling. On these grounds it is suggested that some treatments of ion–atom collisions should be considered less appropriate. (auth)

25159 ELASTIC ELECTRON SCATTERING BY SCREENED POLAR GAS MOLECULES. Boardman, A. D.; Sampanthar, S. (Univ. of Salford, Eng.). J. Phys., B (London), 2: 145-7(Jan. 1969).

The effect of the inclusion of an exponential attenuating factor in the electron–polar-molecule interaction potential is briefly examined. The calculated cross sections are, as expected, lower than in the unscreened case. It is suggested that the exponential factors have their origin in a screening effect due to the pressure of the gas. (auth)(UK)

25160 IMPROVED EQUATION FOR LOWER BOUNDS TO EIGENVALUES: BOUNDS FOR THE SECOND-ORDER PERTURBATION ENERGY. Miller, William H. (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 50: 2758-62(Mar. 15, 1969).

The improved equation for lower bounds to eigenvalues obtained is a generalization of an earlier lower-bound equation given by Gay and another given by Miller. A numerical application to the ground state of the two-electron atom is presented. Upper and lower bounds for the second-order perturbation energy are also presented, and a general upper bound for inverse operators is obtained. (auth)

25161 TRANSITION RATES IN MULTILEVEL SYSTEMS. Williamson, J. H. (Univ. of British Columbia, Vancouver). J. Chem. Phys., 50: 2719-23(Mar. 15, 1969).

The transition rates between levels in a multilevel system can be measured by perturbing the system and observing the response. Previous work has shown that, in general, many different sets of transition rates could account for the same response. In consequence, statistical errors in the computed rates are much larger (e.g., 10,000 times larger) than those in the original data. It is shown here that it is possible to design the experiment so as to avoid this instability. The ideal experiment uses fairly high-frequency sinusoidal perturbations in place of the impulsive or steady-state perturbations usually employed. The application to the measurement of atomic lifetimes and collisional transition rates among excited states is discussed. The method is tested with data obtained from two 6-level electronic circuit, which simulate a hydroxyl molecule and a hydrogen plasma, respectively. (auth)

25162 SUM RULES FOR VARIATIONAL WAVE FUNCTIONS. Dalgarno, A. (Harvard Coll. Observatory, Cambridge, Mass. Smithsonian Astrophysical Observatory, Cambridge, Mass.); Epstein, S. T. J. Chem. Phys., 50: 2837-9(Apr. 1, 1969).

It is demonstrated that the finite set of wave functions obtained by applying the variational principle to a linear combination of basis functions provides bonds to a number of sum rules and that by appropriate choice of the basis functions certain of the sum rules can be satisfied exactly. (auth)

25163 EFFECTIVE POTENTIAL MODEL FOR CALCULATING NUCLEAR CORRECTIONS TO THE ENERGY LEVELS OF HYDROGEN. Grotch, H. (Cornell Univ., Ithaca, N. Y. Pennsylvania State Univ., University Park); Yennie, D. R. Rev. Mod. Phys., 41: 350-74(Apr. 1969).

An attempt is made to re-evaluate the nuclear corrections to the energy levels of hydrogen by using an effective potential approach. The basic idea is to infer from electron–proton scattering a potential that may be applied to the bound-state problem. In lowest order, the potential is chosen from the first-order Feynman diagram for the scattering. With this choice the Breit equation is obtained. It is then solved in an approximate way, in the nonrelativistic limit of the proton, to obtain wave functions accurate enough for use in evaluating the effects of perturbations of the potential. The reduced mass corrections to the fine-structure and the hyperfine-structure levels are readily found. The effect on the hyperfine splitting of the distribution of the proton charge and magnetic moment is obtained by correcting the lowest-order potential to include the proton form factors. A further modification is needed in evaluating additional recoil corrections, of relative order $\alpha m/M$, to the fs and the hfs. This additional term accounts for the failure of the iteration of the lowest-order potential to reproduce the scattering obtained from the second-order Feynman diagrams. The $\alpha^2 m/M$ contribution of the state-dependent mass corrections to the hfs is also analyzed within the context of this approach. All the corrections found are in complete agreement with previous results obtained by the Bethe–Salpeter equation, but the present method has the virtue of conceptual simplicity. 52 references. (auth)

25164 FAST ACTING GAS VALVE FOR THE PRODUCTION OF PLASMA DRIVEN BY A MAGNETOSTRICTIVE ROD. Maeno, Masaki; Goto, Yukihiro (Tohoku Univ., Sendai). Denki Gakkai Zasshi, 88-8: 1507-14(Aug. 1968). (In Japanese).

For the study of the plasma trapping, a fast-acting gas valve driven by a magnetostrictive rod (magnetostrictive valve) was developed, the use of which shortened the switching time of the valve operated by ultrasonic waves in comparison with the usual electromagnetic valve; also, the gas injected into the discharge field was more localized. The switching time of the magnetostrictive valve was about 20 μsec when a laminated nickel rod was used as the oscillator. The quantity of the hydrogen gas injected into vacuum was about 5 mm Hg cc when the pressure of the gas bell was 10 atm and the maximum aperture of the valve was 8 μ. From the measurement of the pressure distribution of the gas pulse when the gas was injected in the direction of the valve axis, it was shown that the injected gas flow through the magnetostrictive valve was more localized than the flow through the electromagnetic valve. In order to confirm the practicability of this valve, the valve was built in the conductor for the center current in the stuffed cusp field apparatus, and it was concluded that the gas quantity, enough to produce plasma by the theta-pinch discharge, was injected through this valve. (NSA of Japan)

25165 RADIATIVE EFFECTS IN SEMICLASSICAL THEORY. Crisp, M. D. (Columbia Univ., New York); Jaynes, E. T. Phys. Rev., 179: 1253-61(Mar. 25, 1969).

Unquantized field calculations are extended to include the effect of an atom's field acting back upon the atom. It is shown that, in the absence of an applied field, semiclassical theory predicts that an atom will decay spontaneously from an excited state with a characteristic time equal to the reciprocal of the Einstein A coefficient for the transition. The theory also predicts that the frequency of the light radiated during a transition will have a small time dependence. The corresponding frequency shifts are compared with the Lamb shift in hydrogen. The derived equations are used to study the response of a many-level atom to an applied, monochromatic field. In the case of a three-level system, it is predicted that optical nutations are not just limited to the resonant transition, but are also present in the fluorescence involving the other level. (auth)

Cosmic Radiation

Refer also to abstracts 25048 and 25508.

25166 (AD–677282) THE VERY-HEAVY NUCLEI IN THE PRIMARY COSMIC RADIATION. PART I. OBSERVATIONS ON THE ENERGY SPECTRUM. Freier, P. S.; Waddington, C. J. (Minnesota Univ., Minneapolis. Cosmic Ray Group). 1968. Contract Nonr-710(60). 33p. (CR–115). CFSTI.

The intensities and energy spectrum of the medium and very heavy, MH- and VH-nuclei, $16 < Z < 30$, present in the primary cosmic radiation were studied using three stacks of nuclear emulsions exposed on high-altitude balloons flown over Fort Churchill, Texas and India. Integral intensities of $Z > 20$ nuclei above energies of 0.225, 1.58 and 7.1 BeV per nucleon were, respectively, 1.50 ± 0.06, 0.403 ± 0.023 and 0.90 ± 0.006 VH-nuclei/sq m ster. sec. In addition, the shape of the energy spectrum of these nuclei was observed in detail for $0.225 < T < 1.0$ BeV per nucleon. The intensities and energy spectra of those nuclei with $16 < Z < 19$ were also studied although with less statistical accuracy. Among approximately 1600 VH-nuclei observed in this study there were none with $Z > 32$. (auth) (USGRDR)

25167 (AD–677283) THE VERY-HEAVY NUCLEI IN THE PRIMARY COSMIC RADIATION. PART II. INTERPRETATION OF THE ENERGY SPECTRA. Waddington, C. J.; Freier, P. S. (Minnesota Univ., Minneapolis. Cosmic Ray Group). 1968. Contract Nonr-710(60). 38p. (CR–116). CFSTI.

An attempt was made to understand the form of the observed energy spectrum of the highly charged, $20 < Z < 30$, nuclei in the primary cosmic radiation. It is shown that the behavior of this

spectrum relative to that of the helium nuclei also present in the cosmic radiation can be explained by assuming that the highly charged nuclei have two components. The first of these components is dominant at high energies and has a spectrum at the source that can be represented as a simple power law with a slope somewhat flatter than that of the source spectrum of the helium nuclei. The nuclei in this component may be regarded as having traversed several g/sq cm of matter between the times of acceleration and of detection. The second component is only of importance at relatively low energies, of a few hundred MeV per nucleon, has a spectrum that falls steeply with increasing energy and cannot simply be represented as a power law. The possible consequences of such a model are briefly considered. (auth) (USGRDR)

25168 (AD-678193) RADIO PULSES FROM COSMIC RAY SHOWERS. Final Scientific Report. Barker, P. R.; Hazen, W. E.; Hendel, A. Z.; Smith, Howard; Shah, N. J. (Michigan Univ., Ann Arbor. Dept. of Physics). Aug. 31, 1968. 11p. (AFOSR-68-2479). CFSTI.

Exploratory observations of radio pulses generated by cosmic-ray showers were made at the Chacaltaya Laboratory of the Laboratorio de Fisica Cosmica of the Universidad Mayor de San Andres, near La Paz, Bolivia. The experiments during the grant period were designed primarily to investigate mechanisms of production of the radio pulses, (a) because of interest in the mechanism as such, and (b) because the results would lead to ideas for use of the radio-pulse method alone for detection of large air showers. (auth) (USGRDR)

25169 (AD-678246) COSMIC RAY INTENSITY VARIATIONS DURING 1967. Scientific Note No. 6. Sandstrom, Arne E.; Dyring, Eric; Larfors, Ove; Lindgren, Stig; Sporre, Bert (Uppsala Univ. (Sweden)). June 15, 1968. Contract AF61(052)-868. 38p. (AFCRL-68-0423). CFSTI.

The recording of cosmic-ray intensity time variation was continued as during the last few years by means of one neutron monitor, one cubical telescope, and four inclined telescopes in Uppsala and Kiruna. Tables and figures give a detailed account of diurnal and semidiurnal variations during 1967. Nine decreases are reproduced in one-hour diagrams. (auth) (USGRDR)

25170 THE EFFECT OF MULTIPLICITY OF SECONDARY PARTICLES PRODUCED IN VERY HIGH ENERGY NUCLEAR INTERACTIONS ON THE MUON COMPONENT OF LARGE AIR SHOWERS. Cachon, Andre; Capdevielle, Jean-Noel; Dupuy, Jean (Observatoire du Pic du Midi, Bagneres-de-Bigorre, France). Compt. Rend., Ser. B, 268: 193-6(Jan. 13, 1969). (In French).

Semi-theoretical calculations of large cosmic ray showers were carried out for various values of the parameters appearing in this phenomenon. These calculations show that the effect of one of these parameters (that connected with the multiplicity of particles produced in nuclear collisions) can be separated from the effects of the others, and knowledge of the numerical value of this parameter permits certain properties of showers to be qualitatively established. (tr-auth)

25171 INVESTIGATIONS OF COSMIC RAY INTENSITY VARIATIONS IN ANTARCTICA. Pomerantz, Martin A. (Franklin Inst., Philadelphia). Antarctic J. U. S., 3: 252-3(Nov.-Dec. 1968).

Features of cosmic ray anomalies detected by ground-based instruments in Antarctica were examined. An unusual event followed the sequence of solar disturbances in September 1966. The cosmic ray flux at the antarctic stations started to decrease on September 14, and on September 15 reached a minimum value about 4% below the pre-event level. However, the intensity reduction at the arctic stations Thule and Alert did not begin until September 15. To analyze the mechanism that produced this remarkable intensity gradient along the Earth's rotational axis, a detailed analysis is being carried out. Another investigation involving the data from McMurdo and South Pole Stations led to the important findings that the long-term (solar cycle) modulation of cosmic rays is symmetric, i.e., the net reduction in the primary flux in the vicinity of the Earth (below the unmodulated galactic level that prevails beyond the boundary of the solar magnetic regime) is the same in the equatorial plane as it is in the direction perpendicular to it. No ground-level events, marking the arrival of solar cosmic rays having energies greater than about 5×10^8 eV, have occurred since January 28, 1967. (BBB)

25172 MAGNETOSPHERIC COSMIC-RAY CUTOFFS AND THEIR VARIATIONS. Hofmann, David J. (Univ. of Wyoming, Laramie); Sauer, Herbert H. Space Sci. Rev., 8: 750-803(Dec. 1968).

Many observations of geomagnetic cutoff phenomena and their implications with respect to the dynamics of charged particles in the geomagnetic field are discussed. Störmer's analytic treatment of the motion of charged particles in a dipole field is briefly reviewed, as are the approximate treatments of charged-particle motions, first developed by Alfvén, which were to find successful application to the more complex fields now known to exist in the magnetosphere. In conclusion, the present understanding of geomagnetic cutoffs, together with some remaining areas of uncertainty, are examined. (auth)

25173 COSMIC-NOISE STUDIES IN RELATION TO IONOSPHERIC ABSORPTION AND SOLAR ACTIVITY. Subramanya Sarma, S. B. S. Bangalore, India, Indian Institute of Science, 1966.

Thesis.

A complete description of the experimental technique is given. The similarity between the cosmic radio noise and the random noise is pointed out, and the possible sources of interfering signals in the measurement of cosmic radio noise are discussed. The method of conversion of the observed cosmic radio noise in terms of random noise is outlined. The theory of propagation of radio waves in the ionosphere is described. A detailed theory of ionospheric absorption is presented. The principle involved in establishing ionospheric absorption using cosmic radio noise is mentioned. The experimental results are given, and these results are discussed in the light of the work done by earlier investigators. The relative importance of various layers of the ionosphere in contributing to the total absorption is evaluated. The diurnal and seasonal variations are discussed. The effect of magnetic activity on the total absorption was studied. The various manifestations of solar activity on the cosmic radio noise records at 28.6 Mc are described; the maximum possible temperature of the quiet sun at this frequency was established. Various types of noise bursts were recognized, and the velocity of shockwave front responsible for the type-II burst was estimated. The flux-density variation with time in the case of type-IV solar continuum radiation showed an interesting result, and the method of obtaining the magnetic field strength (in the solar corona) in the early stages of the type-IV continuum radiation is given. (Indian Sci. Abstr.)

25174 LOW ENERGY DIFFUSE COSMIC X RADIATION. Wilson, B. G. (Univ. of Calgary, Can.). Inst. Space Aeronaut. Sci., Univ. Tokyo, Rep. No. 428, 289-300(Aug. 1968).

Recent measurements of diffuse x rays in the 1- to 10-keV region are reviewed. The results suggest that a single-exponent power-law spectrum, consistent with observations above about 50 keV, is inadequate at lower energies. It is shown that the trend between 100 and 10 keV to a flatter spectrum consistent with the 1- to 10-keV data may be attributable to the possible existence of electron populations in the metagalaxy with different power-law exponents. Such energy spectra arise naturally from a recent model for the evolution of radio sources proposed by Kellermann. It is suggested that the Felton-Morrison hypothesis of the interaction of metagalactic electrons with 3°K thermal photons may therefore play a dominant role in the origin of the diffuse radiation. Two measurements at 0.25 keV favor an alternative source of radiation to explain the large fluxes in this energy region. Continuation of measurements linking the 0.25- and 1.0-keV data is of vital importance in determining the composition and characteristics of the intergalactic gas. (BBB)

25175 IONOSPHERIC FORWARD-SCATTER PROGRAM IN THE ANTARCTIC. Pomerantz, Martin A. (Franklin Inst., Philadelphia). Antarctic J. U. S., 3: 253(Nov.-Dec. 1968).

The ionospheric forward-scatter network designed to study low-energy solar particles in the Antarctic is described, along with some results of measurements. Analytical attention was devoted to studies of the development and occurrence of sporadic E in the solar cap. Under these conditions, and for the path lengths and propagation frequencies of the highest latitude links (Byrd-McMurdo, 1485 km, 23.280 MHz; and McMurdo-Vostok, 1312 km, 23.900 MHz), a minimum plasma frequency of 5 MHz is required to reflect the signal. The data from these links were studied to determine the variations in E_s occurrence as a function of K_p, K_{Vostok}, season, and time of day. For both links, sporadic-E propagation is associated with events that last longer than 1 hr. At L > 20 (McMurdo-Vostok), there are diurnal, seasonal, and K_p-dependent variations. The diurnal variations depend on the season. They are most notable in the longer-lasting E_s events. There is a tendency for the E_s events to persist longer in summer than in winter. At L = 14.4 (Byrd-McMurdo), the variations are similar to those for L > 20 except that the K_p dependence seems less marked and the diurnal distribution does not depend on the season. Calculations aimed at identifying the nature of the precipitating particles with which sporadic E is associated indicate that forward-scatter E_s propagation may be produced by moderate-energy protons. (BBB)

25176 CHEMICAL COMPOSITION OF PRIMARY COSMIC RAYS AT 10^{11} eV. Rappaport, Saul A.; Bradt, Hale V. (Mas-

sachusetts Inst. of Tech., Cambridge). Phys. Rev. Lett., 22: 960-3(May 5, 1969).

An analysis of the nuclear-active particle component of extensive air showers has yielded evidence that the chemical composition of primary cosmic rays at 10^{15} eV cannot consist solely of protons or solely of very heavy nuclei. The data are consistent with the mixed composition observed at lower energy ($\sim 10^{11}$ eV). (auth)

25177 DIURNAL VARIATION OF COSMIC-RAY MUON INTENSITY NEAR GEOMAGNETIC EQUATOR AND THE PRIMARY ANISOTROPY. Wang, C. P. (Case Western Reserve Univ., Cleveland); Lee, A. H. J. Geophys. Res., 74: 2439-42 (May 1, 1969).

Cosmic-ray muon intensity was monitored with a cubical counter telescope at the Univ. of Hong Kong. The telescope is described. The diurnal variation deduced from the data obtained from Jan. to Mar. 1964 is reported and the result is compared with the unusually large directional intensity increase observed by Standil and Bukata (1964), and Bukata and Standil (1965) during the same period. (W.D.M.)

25178 A COMPARISON OF THEORETICAL AND EXPERIMENTAL COSMIC-RAY EQUATORS. Shea, M. A. (Air Force Cambridge Research Labs., Bedford, Mass.). J. Geophys. Res., 74: 2407-13(May 1, 1969).

Utilizing the trajectory-tracing procedure for calculating vertical cutoff rigidities with two different geomagnetic field simulations, theoretical cosmic-ray equators were calculated and compared with experimentally determined positions of the equator. It is shown that the maximum in vertical cutoff rigidity is representative of the theoretical cosmic-ray equator even when nonvertical effects are considered. In addition, it is shown that care must be taken in the routing of an experimental latitude survey, as it is possible to observe a minimum in cosmic-ray intensity that defines a "virtual" cosmic-ray equator. (auth)

25179 TRAINS OF DIURNAL WAVES IN THE MUONIC COMPONENT AT 70 MWE DURING COSMIC-RAY DECREASES. Castagnoli, G. Cini; Dodero, M. A. (Univ., Turin). J. Geophys. Res., 74: 2414-20(May 1, 1969).

Trains of diurnal waves in the muonic component at 70 mwe were found during the preliminary phases of some cosmic-ray decreases. A predecrease the day immediately preceding a Forbush decrease has repeatedly been reported from neutron monitor observations. The analysis indicated that underground data reveal this effect earlier and for a longer period. This is consistent with the interpretation of a Forbush decay as the result of the advance of a shock front. (auth)

25180 BALLOON MEASUREMENT OF PROTON AND ALPHA PARTICLE FLUXES FROM PALESTINE, TEXAS. Lommen, P. W.; Deney, C. L.; Kaplon, M. F. (Univ. of Rochester, N. Y.). J. Geophys. Res., 74: 2319-26(May 1, 1969).

A Cherenkov-scintillation counter telescope was flown by balloon at times close to the minimum of solar activity in 1964–65. Integral proton and alpha particle fluxes above a vertical geomagnetic cutoff rigidity of 4.5 GV were measured to be 610 ± 50 and $104 \pm 12 \times 10^{-4}$ (cm^2 sec ster)$^{-1}$, respectively. When these measurements are compared with previous ones made at similar cutoff rigidities, it is found that the form of the solar modulation of rigidities ≥ 4.5 GV is the same as for much lower rigidities. On one of the flights a drift of the balloon across lines of different geomagnetic cutoff rigidly enabled a differential proton flux measurement of $200 \pm 20 \times 10^{-4}$ (cm^2 sec ster GV)$^{-1}$ at 4.3 GV to be made. (auth)

25181 ACCELERATION OF COSMIC PARTICLES BY ELECTROMAGNETIC WAVES WITH ALTERNATING RATE OF PROPAGATION. Dabydovskii, V. Ya.; Yakushev, E. M. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1796-8(Nov. 1968). (In Russian).

Charged-particle propagation in an electromagnetic field was studied, considering that the field is a plane wave propagating along the z axis with the rate of $V < 1$. An adiabatic invariant was obtained for particles captured in traps in the case of slowly changing wave parameters. The acceleration of the moving trap was induced by electromagnetic waves propagating in the media with density changing in the direction of the propagation. The universal mechanism of acceleration was suggested for the case in which electromagnetic radiation is emitted from comparably dense regions in the cosmos (stellar atmospheres, interplanetary gas clouds, etc.) into rarefied space. (R.V.J.)

25182 DETECTION OF NEUTRINOS FROM THE SUN. de Graaff, T]. (Univ., Groningen, Netherlands). Ned. Tijdschr. Natuurk., 34: 357-68(Dec. 1968). (In Dutch).

The structure of the Sun's interior and the processes occurring are described. A description is given of the Davis experiment on the search for neutrinos from the Sun. It is concluded, on the basis of experimental neutrino astrophysics, that the energy product with thermonuclear processes proceeds principally by means of reactions of the pp chain, whereas the reaction with the C–N chain contributes only a small fraction (less than 9%). The abundance of heavy elements in the Sun is less than 2%, but the predicted neutrino flux was not exceeded. (J.S.R.)

Direct Energy Conversion

Refer also to abstracts 24984 and 25192.

25183 (ALO–2462-9) LEAD TELLURIDE RESEARCH PROGRAM. Final Report. Carlson, R. O.; Kendall, L. F. (General Electric Co., Schenectady, N. Y. Research and Development Center). Oct. 1968. Contract AT(29-2)-2462. 62p. Dep. CFSTI.

Single-phase PbTe doped with sodium or iodine for high temperature thermoelectric power generation was synthesized in quartz tubes or in an autoclave pressurized with argon. The PbTe was hot-extruded into rods whose densities exceeded 99.5% of theoretical. Silver and samarium were tried as substitute dopants. Compatibility tests at 600°C for 1000 hours revealed that some module construction materials such as Lava and Fiberfrax and metals like Ni, Mo, Ta, and W did not alter the electrical properties of p-type thermoelements, whereas air, water vapor, Fe, Mn, Cr, and stainless steel were highly deleterious. Six life test cells were operated with couples held in a 210–550°C gradient for thousands of hours. Mo or W provided a diffusion barrier at the hot end of the couples, but there was still a 3 to 9% degradation in power output over 1000 hour operation, arising mostly from an increase in the p-type thermoelement resistance. (auth)

25184 MECHANISM OF THERMOEMISSION FROM HIGH-MELTING METAL CATHODES. Kan, Kh. S.; Kul'varskaya, B. S. Izv. Akad. Nauk SSSR, Ser. Fiz., 33: 439-44(Mar. 1969). (In Russian).

Studies were made of the equilibrium vapor pressure of metals over SiC cathodes with additions of W, Mo, Ta, Ti, Th, Y, and Hf up to 10 wt % at various reaction temperatures. The curves obtained for the temperature dependence of the thermoemission current density in vacuum showed that the alloying resulted in variable output in carbide cathodes. The most effective in relation to reducing the SiC cathode output were Ti and Th metals. (R.V.J.)

25185 STUDIES ON THERMODYNAMIC AND ELECTRICAL PROPERTIES OF COMBUSTION GAS AND ITS PLASMA. 2. STUDY ON THE COMBUSTION INHIBITING EFFECT OF POTASSIUM SALT IN THE OPPOSITE JET DIFFUSION FLAME. Mori, Yasuo; Otake, Kazutomo (Tokyo Inst. of Tech.). Nippon Kikai Gakkai Rombunshu, 34: 2172-81(Dec. 1968). (In Japanese).

In the open-type MHD power generator, alkali metal salt with low ionizing voltage is added to the combustion gas in order to improve its electrical conductivity, but the alkali metal salt has the effect of prohibiting combustion. In the design of combustors for MHD power generation, it is necessary to consider the effect of the alkali metal salt on reaction velocity. The relation between the activation energy in the whole reaction of the fuel–oxidizer system and the added amount of potassium salt is clarified here, and the decline of reaction velocity due to addition of the potassium salt quantitatively determined, using the diffusion flame by opposite jets and the premixed flame of laminar flow. The apparatus, method, and result of the experiment, and the theoretical analysis of the diffusion flame by opposite jets are described. By adding $K_2S_2O_7$ to the diffusion flame by opposite jets and to the premixed flame of laminar flow of propane and air, the blowout limit and the combustion velocity decreased with increased amount of addition. By theoretical analysis of the diffusion flame by opposite jets, the relation between the blowout limit and the activation energy in the reaction was clarified, and the experimental results of the diffusion flame by opposite jets and the premixed flame of laminar flow showed good agreement. (NSA of Japan)

Fluid Physics

25186 ELECTROGASDYNAMIC POWER GENERATION. Poularikas, A. D. (Univ. of Rhode Island, Kingston). Int. J. Elec. Eng. Educ., 6: 521-30(Mar. 1969).

General characteristics, history, problem and research areas, and applications of electrogasdynamic (EGD) generators are reviewed. Four major areas of EGD which need to be further investigated are considered: means of charge production and separation; charge flow in the region of conversion; distribution of the electric field, voltage, and pressure along and across the channel; and utilization of the generator as a volume amplifier, rectifier,

and sound generator. The critical problem of ion slip and charge spreading has been practically solved by using aerosols. The remaining problems in four areas are considered; charge production, working gases, overall efficiency, and electric field configurations. The main objective in the production of charges is to produce high charge concentration with high-speed flows. This creates difficulties due to electrostatic repulsion. Although spray or induction charging techniques have been mentioned, practically all experimental work thus far has been conducted using corona discharges. Alternative methods have been proposed such as thermionics, irradiation, and microwave breakdown, but remain to be explored. Another problem is the incorporation of the EGD generator into an overall conversion cycle of heat into electricity. Attempts to overcome this problem are outlined. Corrosion and breakdown problems must be solved. In particular, when fossil-fuel systems are used, the problem of corrosion and ash deposition will appear. Material problems are not so severe as with MHD generators where much hotter gases are used. Advantages of EGD generators compared with MHD generators are enumerated. 32 references. (BBB)

25187 SOLUTIONS OF CERTAIN LIMITING PROBLEMS IN MAGNETOHYDRODYNAMICS. Sanchez-Palencia, Enrique (Ciudad Univ., Madrid). J. Mec., 7: 405-26(Sept. 1968). (In French).

The existence of the magnetohydrodynamic 3-dimensional steady flow of a viscous, incompressible, and conducting fluid past a body was investigated when the velocity and the magnetic field are imposed at infinity. The following 3 cases were examined: (a) The body is an insulator with smooth boundary and the same magnetic permeability as the fluid; (b) The body is a flat plate at zero angle of attack; (c) The surface of the body is not smooth. The existence of a weak solution of the boundary problem is proved in the case (a) with the hypothesis that the magnetic Reynolds number is sufficiently small; in the case (b) without any restriction, and in the case (c) if the viscous and magnetic Reynolds numbers are sufficiently small. (BBB)

25188 STEADY MAGNETODYNAMIC FLOW AROUND A NONCONDUCTING WEDGE IN THE CASE OF A CROSSED FIELD. Levy, Therese (Faculte des Sciences, Paris). J. Mec., 7: 583-97(Dec. 1968). (In French).

A study was made of the steady, 2-dimensional flow of a perfectly conducting fluid past a nonconducting wedge in the case where the magnetic field is orthogonal to the flow velocity. The solution was sought in the form of uniform regions with shock waves attached at the apex. When a solution of that type exists, it contains 4 shock waves. Numerical computations gave 2 solutions. When the angle of the wedge is small, one of these solutions gave the results of the linearized theory, and the other solution gave a strong hydrodynamic shock in the limit of weak magnetic field. (BBB)

25189 EFFECT OF WALL CONDUCTIVITY ON HEAT TRANSFER BY HARTMANN'S FLOW IN THERMAL ENTRANCE REGION. Reddy, P. Govinda; Jain, M. K. (Indian Inst. of Tech., New Delhi). Proc. Nat. Inst. Sci. India, Part A, 34: 337-53 (Nov. 1968).

The problem of temperature distributions and heat transfer in a thermal entrance region, which results when a liquid flows under a constant pressure gradient between parallel walls at rest and are electrically conducting, has been investigated. The effect of internal heat generation by Joule heating has been taken into account while viscous dissipation is neglected. Boundary conditions are prescribed uniform heat flux at wall and uniform wall temperature. The use of orthogonal functions to solve the energy equation in the entrance region leads to an eigenvalue problem of Sturm–Liouville type differential equation which has been solved by the Ritz variational method. From the solutions and results it can be observed that the temperature distribution and Nusselt number depend on $(\phi_1 + \phi_2)$, the sum of the wall conductance ratios rather than on individual values of ϕ_1 and ϕ_2. Considerable effect can be noticed on these due to the wall conductivity. (auth)

25190 MAGNETOHYDRODYNAMIC SHOCK WAVES IN NON-ALIGNED FLOW. Moricka, Shigeki; Spreiter, John R. (Ames Research Center, Moffett Field, Calif.). J. Plasma Phys., 3: 81-96(Feb. 1969).

The steady shock discontinuity in the flow of a perfectly conducting gas with an arbitrarily oriented magnetic field is considered by taking as the parameters the Mach number, the Alfvén Mach number, the magnetic field direction, and the shock angle. The shock solutions satisfying the conservation laws, as well as the entropy and evolutionary conditions, are given by the roots of a simple cubic equation and the associated formulas. Several special cases are discussed analytically and numerically. The possible types of magnetohydrodynamic shock waves are shown on the speed-deflection phase plane, and the possible shock configurations in the physical space are discussed on the basis of these. (auth)(UK)

25191 EFFECT OF TENSOR CONDUCTIVITY ON CONTINUUM MAGNETOGASDYNAMIC FLOWS. Tang, J. Y. T.; Seebass, R. (Cornell Univ., Ithaca, N. Y.). Quart. Appl. Math., 26: 311-20 (Oct. 1968).

Much recent work on magnetogasdynamic phenomena has included the approximation that the electric current flows in the direction of the electric field vector. Actually charged particles in a magnetic field tend to drift in a direction perpendicular to both the electric and magnetic fields, giving rise to the Hall effect. The electrical conductivity becomes a tensor quantity. The usual approximation of scalar conductivity is valid only when the cyclotron frequency of the particles is much less than their collision frequency. Otherwise the Hall effect must be taken into consideration. The effects of tensor conductivity upon aligned-fields magnetogasdynamic flow when the electron cyclotron frequency is of the same order of magnitude as the collision frequency are now determined. Analytical solutions for the flow fields about simple profiles can easily be obtained for all regions of the Taniuti–Resler–Imai diagram. These solutions exist everywhere provided $R_m^{\frac{1}{2}}\epsilon = o(1)$, are valid when $R_m^{-1} = o(1)$, and satisfy the appropriate boundary conditions on the body and at infinity. A figure includes the qualitative effects of magnetic Reynolds number and tensor conductivity upon flow fields in different regions of the Taniuti–Resler–Imai diagram. The detailed solution for a specific biconvex profile has been carried out to confirm qualitative predictions. The major effect of tensor conductivity is to introduce a new mode in the form of a wake which is named the Hall wake. The structure of the Hall wake is quite different from that of the scalar wake. This wake may have significant implications with regard to the interpretation of probe measurements made for the purpose of plasma diagnostics. (BBB)

25192 OHM'S LAW FOR THE IONIZED GAS IN THE MHD GENERATOR. Celinski, Z. (Instytut Badan Jadrowych, Warsaw). Arch. Elektrotech. (Warsaw), 17: 611-28(1968). (In Polish).

The 3-fluid approximation is assumed in this analysis. On the basis of macroscopic equations of motion for electrons, ions and neutral atoms, a generalized Ohm's law with terms depending upon the plasma velocity and magnetic field is derived. With simplifying assumptions the generalized Ohm's law can be reduced to the equation given by Cowling. Assumptions leading to the simplified expression of Ohm's law valid for the ionized gas in the MHD generator channel are discussed. The analysis and physical interpretation for the ion slip effect, ion and electron currents, and ion and electron electrical conductivity are given. (BBB)

Geophysics (Upper Atmosphere)

Refer also to abstracts 24353, 24480, 25090, 25105, and 25172.

25193 (AD-679216) LABORATORY STUDIES OF PROPAGATION OF MAGNETIC DISTURBANCES IN THE MAGNETOSPHERE. Final Report, June 1, 1966–April 30, 1968. Gore, Joseph V.; McKay, Donald H.; Tam, Sebastian Y. K.; Johnston, Tudor W. (RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.). July 1968. Contract AF19(628)-6126. 91p. (RR-7-801-67; AFCRL-68-0415). CFSTI.

Scaling factors for laboratory experiments relevant to magnetospheric disturbances are discussed, with particular application to a terrella-plasma stream experiment. Owing to the limited success of this terrella experiment, a program for laboratory study of whistler waves in a large magnetoplasma was conceived. Future work along these lines is likely to yield very interesting results for plane wave behavior and whistler antenna characteristics. (auth) (USGRDR)

25194 (ORNL-tr-1920) VAN ALLEN RADIATION BELTS. Touzain, Philippe (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Translated for Oak Ridge National Lab., Tenn., from report CEA-Bib-103. 33p. Dep. CFSTI.

An abstract of the original French report appears as NSA 22: 11311. (L.M.T.)

25195 VLASOV-EQUATION STUDY OF THE GEOMAGNETIC RING CURRENT. Sestero, A. (London Univ. CNEN, Frascati, Italy). Nuovo Cim., Lett., 1: 384-6(Mar. 1, 1969).

It is the purpose of the present note to point out that in an axisymmetric situation it is possible to give a kinetic description of a plasma ring current in a dipole field which is exact, that is, which is based on an exact solution of the Vlasov equation for ions and electrons. The latter can be constructed by making use of the existing exact constants of the motion, in a rotationally symmetrical field. (W.D.M.)

25196 INNER-BELT VAN ALLEN RADIATION. Freden, Stanley C. (Aerospace Corp., El Segundo, Calif.). Space Sci. Rev., 9: 198-242(Mar. 1969).

A survey of the present state of knowledge about the inner radiation zone is presented. This includes a historical review of empirical data and theoretical considerations concerning electrons, protons, and heavier particles. Included are results obtained from the various high-altitude nuclear tests. Recent experimental results are presented and some newer theoretical ideas, such as pitch-angle scattering and radial diffusion, are discussed as applied to the data. Comparisons of the measured fluxes, spectra, and time variations with the theoretical calculations are made where possible. Some conclusions are drawn pertaining to the sources and loss processes for the trapped particles, and some comments are made regarding future measurements in the inner zone. (auth)

25197 DAILY VARIATIONS OF THE GEOMAGNETIC FIELD. Price, Albert T. (Univ. of Exeter, Eng.). Space Sci. Rev., 9: 151-97(Mar. 1969).

Several methods for the worldwide analysis of the S field (daily magnetic variations) have been developed. A possibility now being studied is the completely automatic evaluation and construction by computers of ionospheric current charts for any day and any epoch UT. Some theoretical and statistical papers are briefly reviewed. These include discussions of the day-to-day variability of S, seasonal changes of the S field, the nature of the equatorial electrojet, the possibility of solar-wind effects contributing to the daily variations, and the modification of the dynamo theory to take account of the possible flow of electric current from the ionosphere along magnetic lines of force in the magnetosphere. Finally, an attempt to extend the dynamo theory of S by treating the ionosphere as a three-dimensional medium, instead of regarding it as a thin shell, has revealed that, although the relations between the horizontal components of electric field and current density in the dynamo layer are given with reasonable accuracy by the well-known layer equations, the assumption, implicit in the thin shell treatment, that the horizontal currents are nondivergent is not in fact true. Hence, a revision of some earlier theoretical work on S appears necessary. (auth)

25198 MAGNETOSPHERIC PLASMA MOTION ASSOCIATED WITH TIME FLUCTUATIONS OF MAGNETIC FIELD IN THE SOLAR WIND. Tamao, Tsutomu (Tokyo Univ.). Rep. Ionosphere Space Res. Jap., 22: 257-71(Dec. 1968).

It is assumed that the observed time fluctuations of the north–south component of the interplanetary magnetic field are superposed perturbations on the stationary spiral field, belonging to the incompressible hydromagnetic disturbances (the so-called Alfvén mode). With this view, a possibility of the macroscopic interaction of the magnetosphere with these perturbations, resulting from penetration of the associated electric current, and inducing plasma motion within the magnetosphere is considered, when the magnetosphere is permeated by the large-scale incompressible disturbances of the solar wind. Using a particular two-dimensional model with the one-fluid approximation, the expressions of the associated magnetospheric perturbations are obtained in the case of a sinusoidal variation of the inducing Alfvén mode perturbation. The result depends critically on magnitudes of several parameters in the stationary state, for example, bulk velocities, plasma densities, and magnetic field intensities in the solar wind and magnetospheric regions. Possible patterns of the induced magnetospheric plasma motion are discussed for several phases of the inducing field, in connection with the observed coherent relationships between changes of the interplanetary magnetic field and the geomagnetic variations, especially DP 2 fluctuations. (auth)

25199 AN EXPERIMENTAL STUDY OF THE POLAR LOWER IONOSPHERE USING VERY LOW FREQUENCY RADIO WAVES. Helms, Ward Julian. Seattle, Univ. of Washington, 1968. 111p.

Thesis.

A new experimental technique was devised to study the lower ionosphere using vlf radio waves. This technique determines an accurate phase height of reflection without ambiguity. A system implementing this technique was designed, constructed, and put into operation at Byrd Station, Antarctica. Seven months of synoptic data on the polar lower ionosphere were obtained and analyzed. The analysis of these data yielded the average behavior of the polar D region during periods of total darkness, continuous sunlight, and day–night night–day transition under both quiet and disturbed magnetic conditions. This analysis indicates that the dominant ionization production mechanism is related to energetic particle precipitation from the magnetosphere and is only slightly affected by solar ultraviolet radiation. Phase height measurements obtained during three large PCA events are shown. The event of July 7, 1966, occurred during the Antarctic winter when the ionosphere was in total darkness. During this event the D-region phase radar is shown to be a very sensitive ground based indicator of the arrival of solar protons in the lower ionosphere. Two intense PCA events occurred during the Antarctic spring on August 28, 1966, and September 2, 1966 when the D region was sunlit for part of the day and dark for the remainder. Detailed analysis of the phase height, zenith angle relationship during these events is presented. High time-resolution measurements taken during polar substorm activity indicate that a very rapid phase-height decrease usually occurs during the auroral breakup phase. This drop is closely related to the termination of vlf hiss. (Disser. Abstr.)

25200 TOPSIDE SOUNDING OF THE EARTH'S IONOSPHERE. Chapman, J. H.; Warren, E. S. Space Sci. Rev., 8: 846-65(Dec. 1968).

The evolution of topside sounding through rocket and satellite experiments is reviewed. Topside sounding has proved valuable for revealing the structure of the upper ionosphere and for investigating the resonance properties of a magnetoplasma. The limits of the present knowledge of these rapidly developing subjects are discussed. Topside sounding is predicted to have a long and useful role in exploration of the ionosphere of Earth and other planets. (auth)

25201 COMPARISON OF MAGNETIC FIELD VARIATION ON THE GROUND, IN THE MAGNETOSPHERE, AND INTERPLANETARY SPACE. Iijima, Takesi (Tokyo Univ.). Rep. Ionosphere Space Res. Jap., 22: 295-300(Dec. 1968).

The results are given from a preliminary correlation study between the interplanetary magnetic field (measured at ~R_E by IMP-1) and various elements of polar magnetic disturbances (SP, AEJ, and Dst). The following elements are compared for three days in Dec. 1963: three components of the interplanetary magnetic field, ground level geomagnetic disturbances in SP, auroral electrojets, and Dst. (W.D.M.)

25202 HYDROGEN EMISSION PRECEDING AURORAL BREAKUP. Tsuruda, Mitsuko; Kaneda, Eisuke (Tokyo Univ.). Rep. Ionosphere Space Res. Jap., 22: 289-94(Dec. 1968).

This note emphasizes the appearance of Hα emission preceding auroral breakup, after a preliminary analysis of the data by a Meinel-type patrol spectrograph, at Syowa Base, Antarctica in 1966. The auroral spectra were photographed on 16-mm film with an exposure of one hour along the geomagnetic meridian. (W.D.M.)

25203 LOCATION OF TEMPORARY RADIATION ZONES CAUSED BY GEOMAGNETIC STORMS. Takao, Kazuaki; Nakadan, Yasuhiro (Kyoto Univ.). Rep. Ionosphere Space Res. Jap., 22: 279-84(Dec. 1968).

In order to locate the radiation source discussed in the previous paper, the authors have devised a new method to find the attitude of Explorer 30 when the direct measurement of the aspect is missing. Analysis of the time variation of the Sun aspect angles gives the orientation of the spin axis of the satellite, enabling one to know the direction of radiation sources at every instant. The results show that the radiation is probably due to reflection particles from the mirror point which are more abundant on the night side. (auth)

25204 ANOMALOUS RESPONSES OF THE GM COUNTER ON EXPLORER 30. Takao, Kazuaki; Nakadan, Yasuhiro (Kyoto Univ.). Rep. Ionosphere Space Res. Jap., 22: 273-8(Dec. 1968).

The solar-radiation monitoring satellite Explorer 30 occasionally sent saturated signals from the 1 to 8 Å GM counter. Out of 477 passes observed at Kyoto during the period from March 1966 to November 1967, such cases occurred 60 times. The cause was found to be high-energy particles in the Van Allen belts. Statistical investigation reveals the time and space dependence of the occurrence of the phenomena. The relation with solar activity is also discussed. (auth)

25205 MULTI-COMPONENT DIFFUSION IN THE TOPSIDE IONOSPHERE. Kamiyama, Hiroshi (Tohoku Univ., Sendai). Rep. Ionosphere Space Res. Jap., 22: 249-56(Dec. 1968).

The basic formula for diffusion in a multiple-gas mixture is applied to the ionic diffusion in the topside ionosphere where the concentration of each of the ionic constituents is not sufficiently small compared with that of the neutral atmosphere. Due to the large cross section for the Coulomb collision between ions, the ionic diffusion velocity is controlled by the presence of the other kinds of ions when their concentrations exceed about one-hundredth of the neutral concentration. The expressions are derived from the basic formula for the diffusive flows of H^+ and O^+ in the ionosphere at great heights. The distribution of each of the ionic concentrations is computed for a model in which a constant diffusive flow of ions exists in the topside ionosphere. The ion distribution is shown to be related to the distribution of the other kinds of

ions, not only because of the change in the mean ionic mass but also because of the requirement to satisfy the diffusion relation. (auth)

25206 IONOSPHERIC EFFECT ON GEOMAGNETIC MICROPULSATIONS AT LOW LATITUDES. Fukunishi, Hiroshi; Hirasawa, Takeo (Tokyo Univ.). Rep. Ionosphere Space Res. Jap., 22: 235-48(Dec. 1968).

In addition to the fine-structured regular pulsation called "pearls," there are two kinds of persistent continuous micropulsations at low latitude in the pc 1, 2 range (0.1 to 2.0 Hz). The frequencies of these pulsations show a systematic daily variation, almost unchanged in the daytime and a gradual rise throughout the night reaching maximum before sunrise. Two noteworthy phenomena concerning these continuous pulsations are often recognized on the ground; one is a gradual fadeout of the continuous pulsations from higher- to lower-frequency components in the morning hours, and the other is sub-band spectral structure of the pulsations throughout the night. The gradual fadeout around sunrise hours is shown to be due to a screening effect of the ionosphere with increasing ionization. The sub-band structure of the continuous pulsation is suggested to result from a waveguide propagation through the ionospheric duct around the F2 peak from high-latitude regions. (auth)

25207 PROPAGATION OF ALFVEN WAVES IN THE MAGNETOSPHERE. Hayakawa, Masashi; Ohtsu, Jinsuke (Nagoya Univ., Japan). Kakuyugo Kenkyu, 22: 308-22(Mar. 1969). (In Japanese).

The guiding of Alfvén waves along the Earth's field-aligned column in the magnetosphere is discussed by use of wave theory. The radial-density distribution perpendicular to the magnetic field is assumed to be Gaussian. The method in which the fields are expanded into power series of the radial distance from the column axis was used. The condition for trapping in the duct is discussed for enhanced and depressed ducts. The existence of a trapping-frequency region closely related to the modulation factor is demonstrated, and the trapping duct width is also estimated. (NSA of Japan)

25208 ENERGY TRANSFER ACROSS THE MAGNETOSPHERIC BOUNDARY: A COMPUTER SIMULATION OF THE CROSS-FIELD HEAT TRANSFER IN A COLLISIONLESS PLASMA. Obayashi, Tatsuzo (Tokyo Univ.); Tsuda, Takao. Inst. Space Aeronaut. Sci., Univ. Tokyo, Rep. No. 429, 301-8(Sept. 1968).

A computer experiment was performed that simulated the condition of the earth's magnetospheric boundary where an appreciable flow of energy is entering the magnetosphere from the high-temperature domain of the solar wind. A one-dimensional sheet model was employed and the rate of heat flow was computed for the collisionless plasma in which the particles are transported across the static magnetic field. It is shown that the effective transfer rate of heat energy across the magnetic field can attain a value 10^8 times as large as that estimated by the classical formulas of transport phenomena. An interpretation on the physical mechanism is suggested in terms of the wave–particle interactions in the collisionless regime. It is shown that magnetic turbulences generated at the magnetopause act to destroy the anisotropy of diffusion in such a manner that $D_{\parallel}$ and $D_{\perp}$ approach an effective value $D_e \simeq \sqrt{D_{\parallel} D_{\perp}} = v\lambda_{\perp}$. (BBB)

25209 DIRECTION OF ARRIVAL OF HF RADIO WAVES DEDUCED FROM IONOSPHERIC ELECTRON CONTENT GRADIENTS. Rao, N. Narayana (Univ. of Illinois, Urbana). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas Propagation, AP-17: 111-13(Jan. 1969).

Ionospheric electron content gradients are obtained from Faraday rotation observations of near simultaneous passages of the crossed-path radio beacon satellites BE-B and Be-C. Bearing deviation of an hf signal computed from the content gradient information is compared with simultaneously measured values in a radio direction-finding experiment. (auth)

25210 POLAR-CAP SPORADIC E. Gerson, N. C. (Syracuse Univ., N. Y.). Can. J. Phys., 47: 931-48(Apr. 15, 1969).

Backscatter probings (at 28 MHz) of the Arctic ionosphere were made at Alert, Canada, for almost two years. A skewed distribution around the site was found with (a) maximum occurrences constrained to the northeast within ±30° of the great circle through Alert and the principal northern magnetic dip pole, (b) a secondary maximum to the south, and (c) a marked dearth of observations as a tongue from the west (250 to 280°) to about 800 km in the east. The annual pattern was almost identical with the summer and winter patterns. Equinoctial distributions were distinct. The maximum broadened to include the sector in the northeast within the great circles passing through Alert and the dip pole, and Alert and the geomagnetic pole. The secondary maximum and the tongue from the west of very low occurrences vanished. Seasonally, a pronounced maximum was found in the period June to August, and a weak secondary maximum during the equinoctial months. Diurnally, activity was present from 0700 to 1900 LST with a single peak near 1300 LST. Slight deviations from this pattern were noted in winter and summer. In the equinoxes, a plateau or double peak seemed present in the afternoon. Returns from the azimuth of Thule correlated with vertical-incidence sporadic-E frequencies from Thule multiplied by the secant factor. No correlation with similar data from Resolute Bay was present. Indications of direct backscatter from field-aligned irregularities were found despite the large angles off perpendicularity. Es occurrences, after a lag of 12 days, seemed to be associated with appreciable increases in the daily value of a_p. None of the results were predicted by standard maximum usable frequency prediction procedures. Two mechanisms seem possible for clarifying the results: (a) for the summer maximum, the E_s layer tilted upwards to the principal northern dip pole; and (b) for the secondary equinoctial maximum, the daily swing of the auroral oval through the antenna beamwidth. (auth)

25211 RELATIVISTIC ELECTRONS CONFINED WITHIN THE NEUTRAL SHEET OF THE GEOMAGNETIC TAIL. Retzler, J.; Simpson, J. A. (Univ. of Chicago). J. Geophys. Res., 74: 2149-60(May 1, 1969).

The Pioneer 7 deep space probe passed through the geomagnetic tail in 1966 and crossed the magnetic neutral sheet at ~19 and 38 R_E. Electrons with kinetic energies >400 keV were found to be concentrated in a narrow region centered in the neutral sheet, confirming the detection of neutral sheet electrons by Murayama and Simpson with the IMP 1 satellite in 1964. The electron fluxes >400 keV do not extend outside the neutral sheet. At ~38 R_E the anisotropy of the electron distribution was measured by using the spin of the spacecraft and was shown to be less than 20%, consistent with the absence of any electron anisotropy within the sheet. There was no evidence for low pitch-angle streaming of electrons. Most of the experimental evidence points to electron acceleration within the sheet, although this question is not settled. It appears that neutral sheet electron confinement and propagation is determined mainly by the bifurcation of the magnetic field and by the electrons drifting in the electric fields of the sheet. This phenomenon is the only example of its type so far identified in nature. The magnetic neutral sheet crossings probably detected by Ness and collaborators with the Pioneer 7 spacecraft at ~1000 R_E were also examined for neutral sheet electrons. It is shown that the fluxes present at ~ 20 to 40 R_E radii (50 times cosmic-ray background) could not have been observed at 1000 R_E. In the geomagnetic tail outside the neutral sheet the directional distribution of >400-keV electrons was measured in the flux "islands," which occasionally appear above the cosmic-ray background level. The electron distributions are isotropic to within 25%. The origin of these "islands" is discussed. (auth)

25212 PENETRATION OF SOLAR PROTONS TO SYNCHRONOUS ALTITUDE. Paulikas, G. A.; Blake, J. B. (Aerospace Corp., El Segundo, Calif.). J. Geophys. Res., 74: 2161-8 (May 1, 1969).

Solar proton fluxes in two energy intervals (5 to 21 MeV and 21 to 70 MeV) were measured with detectors aboard the geostationary ATS 1 satellite during the solar proton event that began on January 28, 1967. Comparison with data obtained by satellites outside the magnetosphere shows that (a) protons with energies greater than 21 MeV have essentially free access to synchronous altitude; (b) protons in the 5- to 21-MeV energy interval show a diurnal variation with the flux approaching the interplanetary flux level near local midnight. The transmission efficiency of the magnetosphere is not well organized by either the local (synchronous) magnetic field or the Kp index. (auth)

25213 CONVECTION ELECTRIC FIELDS AND THE DIFFUSION OF TRAPPED MAGNETOSPHERIC RADIATION. Birmingham, Thomas J. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 74: 2169-81(May 1, 1969).

The possible importance of time-dependent convection electric fields as an agent for diffusing trapped magnetospheric radiation inward toward the Earth is examined. By using a formalism (Birmingham, Northrop, and Fälthammar, 1967) based on first principles, and by adopting a simple model for the magnetosphere and its electric field, a one-dimensional diffusion equation to describe statistically the loss-free motion of mirroring particles with arbitrary but conserved values of the first two adiabatic invariants M and J is derived. Solution of this equation bears out the fact that reasonable electric field strengths, correlated in time for no longer than the azimuthal drift period of an average particle, move particles toward the Earth at a rate at least an order of

magnitude faster than electric fields whose source is a fluctuating current on the magnetopause. (auth)

25214 DIFFUSION OF EQUATORIAL PARTICLES IN THE OUTER RADIATION ZONE. Schulz, Michael; Eviatar, Aharon (Bell Telephone Labs., Murray Hill, N. J.). J. Geophys. Res., 74: 2182-92(May 1, 1969).

Expansions and contractions of the permanently compressed magnetosphere lead to the diffusion of equatorially trapped particles across drift shells. A general technique for obtaining the electric fields induced by these expansions and contractions is described and applied to the Mead geomagnetic field model. The resulting electric drifts are calculated and are superimposed upon the gradient drift executed by a particle that conserves its first (μ) and second (J = 0) adiabatic invariants. The noon–midnight asymmetry of the unperturbed drift trajectory (resulting from gradient drift alone) is approximated by means of a simple model. In this model the angular drift frequency is found to be the geometric mean of a particle's angular drift velocities at noon and midnight. The radial diffusion coefficient $D = (1/2)(\Delta L)^2/\text{time}$ is calculated as a function of the McIlwain parameter L and in terms of the spectral density of fluctuations in the stand-off distance of the magnetosphere boundary. Because the unperturbed drift trajectories are asymmetric, drift-resonant diffusion of particles is produced by spectral components at all harmonics of the drift frequency, although the first (fundamental) harmonic is the major contributor. (auth)

25215 MORPHOLOGY OF ELECTRON CONCENTRATION ENHANCEMENT AT A HEIGHT OF 1000 KILOMETERS AT POLAR LATITUDES. Sato, Teruo; Colin, Lawrence (Ames Research Center, Moffett Field, Calif.). J. Geophys. Res., 74: 2193-2207(May 1, 1969).

A study based on Alouette 1 data of electron concentration enhancement at a height of 1000 km at polar latitudes during 1962–1964 is presented. The major features are: (1) Enhancement occurs in three apparently independent concentric zones, zones 1, 2, and 3. Zone 1 includes the area with invariant latitudes higher than about 80°. The upper boundaries of zones 2 and 3 are, respectively, at approximately 80° and 73° at magnetic noon and at somewhat lower latitudes at magnetic midnight. The extent or width of each zone varies with season and magnetic activity, and within each zone enhancement occurs sporadically in space and time. (2) Enhancement occurs with maximum frequency at different magnetic local times in each zone. Occurrence frequencies and amplitudes are subject to magnetic local time, seasonal and magnetic activity effects. The latter two effects on occurrence frequency are especially notable in zones 1 and 3. It is suggested that the enhancement is caused by particle ionization due to precipitation of low-energy electrons (E < 1 keV). (auth)

25216 STORM-TIME VARIATIONS OF THE ELECTRON CONCENTRATION IN THE POLAR TOPSIDE IONOSPHERE. Sato, Teruo; Chan, K. L. (Ames Research Center, Moffett Field, Calif.). J. Geophys. Res., 74: 2208-16(May 1, 1969).

Storm-time (Kp > 4) variations of electron concentration in the polar topside ionosphere were studied. Variation profiles at invariant latitudes higher than 60° were derived for 24 Alouette 1 satellite passes directly over or near the north geomagnetic pole. The results show that storm-time variations depend on magnetic local time, invariant latitude, and altitude. The cause of the variations is discussed. (auth)

25217 ORIGIN OF WATER CLUSTER IONS IN THE D REGION Fehsenfeld, F. C.; Ferguson, E. E. (Environmental Science Services Administration, Boulder, Colo.). J. Geophys. Res., 74: 2217-22(May 1, 1969).

Laboratory studies of the ions produced by the addition of water vapor into flowing streams of O_2^+ (or NO^+) ions have led to a vapor phase reaction scheme starting with O_2^+ that seems likely to be responsible for the formation of the observed water cluster ions H_3O^+, $H_5O_2^+$, $H_7O_3^+$, etc. in the D region of the ionosphere. Experimental difficulties have precluded quantitative rate constant measurements so far, and in addition the D-region water vapor concentration is uncertain so that only a qualitative scheme is possible at this time. The $O_2(^1\Delta_g)$ photoionization source recently proposed by Hunten and McElroy is presumed to be the necessary precursor O_2^+ source. The reaction scheme involves O_4^+ and $O_2^+ \cdot H_2O$ as intermediate ions; these ions are possibly present in observable concentrations in the D region. Nitrous acid (HNO_2) production is proposed to be an end result of successive hydrations of atmospheric NO^+. The hydration of the atmospheric NO^+ and O_2^+ ions and the formation of O_4^+ are expected to increase somewhat the effective electron recombination coefficient in the ionosphere. (auth)

25218 ION PAIR ANNIHILATION BY AEROSOLS IN THE LOWER IONOSPHERE. Hodges, R. R. Jr. (Southwest Center for Advanced Studies, Dallas). J. Geophys. Res., 74: 2223-8 (May 1, 1969).

The average rate at which a single aerosol particle captures and annihilates ion pairs in the lower ionosphere is found by analysis of the steady-state distribution of charge in an ensemble of identical particles. With knowledge of the distribution of sizes of particles it is possible to determine the time constant for ion-pair annihilation due to an aerosol. A measured particle size distribution in a noctilucent cloud is shown to imply an annihilation time constant of about 2 minutes, indicating that the cloud in question should have noticeably modified the distribution of ionization in its vicinity. (auth)

25219 THERMAL STRUCTURE OF AN ALOUETTE 2 TOPSIDE PROFILE AS DEDUCED FROM ROCKET MEASUREMENTS. Hanson, W. B. (Southwest Center for Advanced Studies, Dallas); Sanatani, S.; Brace, L. H.; Findlay, J. A. J. Geophys. Res., 74: 2229-39(May 1, 1969).

A Javelin rocket with a payload of ionospheric instruments was launched from Wallops Island in conjunction with an overpass of the Alouette 2 and Explorer 31 satellites. The rocket-measured values of ion and electron temperatures, which had large positive gradients with height, were found to be consistent with the measured electron concentration profile, though this same profile was also consistent with an isothermal plasma. A downward heat flux from the magnetosphere of 1.9×10^{10} eV cm^{-2} sec^{-1} was deduced, which could be supplied by an upward flux of photoelectrons from the F layer of approximately 1.5×10^9 cm^{-2} sec^{-1}. (auth)

25220 SOME MIDLATITUDE SPORADIC-E RESULTS FROM THE EXPLORER 20 SATELLITE. Cathey, E. Henry (Amarillo Coll., Tex.). J. Geophys. Res., 74: 2240-7(May 1, 1969).

A study based on satellite observations shows that sporadic-E clouds have an average length of 170 km; x-mode blanketing lengths are found to be longer than those for o mode signals. Some double-layer data are also given. Separation distances between E_s clouds are shown to increase as a function of height. Horizontal variations of E_s structure are presented, and a convex E_s structure is offered as the most probable explanation of W echoes. (auth)

25221 EFFECT OF ION DRAG ON PROPAGATION OF ACOUSTIC-GRAVITY WAVES IN THE ATMOSPHERIC F REGION. Liu, C. H.; Yeh, K. C. (Univ. of Illinois, Urbana). J. Geophys. Res., 74: 2248-55(May 1, 1969).

The effect of ion drag on propagation of acoustic–gravity waves in an isothermal atmospheric F region is studied. The basic assumption is that ions move only along the magnetic lines of force with a velocity equal to the component of velocity of neutrals along the same direction. If the "collision" frequency is constant as is the case near the F peak of the ionosphere, a general refractive index expression is derived. The refractive index is in general complex, indicating damping of the wave. Studies on two simple examples show that this damping is extremely large for gravity waves and still appreciable for acoustic waves. Further, this damping depends strongly on the direction of propagation. The angular preference on damping may be susceptible to experimental verification. For the case of varying "collision" frequency, an exponential height-dependent model is studied. The resulting reflection coefficient shows that reflection can be appreciable if the collision frequency is not slowly varying over one vertical wavelength. (auth)

25222 MULTIPATH EFFECTS IN TOPSIDE SOUNDING IN IONOSPHERIC DUCTS. Shmoys, J. (Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.). J. Geophys. Res., 74: 2265-70(May 1, 1969).

Ionograms that would be obtained by an ionosonde in a vertical depletion duct in a horizontally stratified isotropic plasma are calculated. In addition to the trace resulting from vertical (i.e., along the duct axis) propagation, there are traces associated with ray paths making 1/2, 1, 3/2, ... oscillations about the duct axis. It is shown that the shape of these traces depends very strongly on the manner in which the electron concentration varies across the duct. Ducts that are nearly homogeneous in the center and have large density gradients surrounding this central column yield "nose"-shaped traces very much like those often seen in Alouette 2 ionograms. Electron concentration variation faster than quadratic with distance from duct axis is required for this type of trace. For ducts with slower than parabolic variation (e.g., Epstein type) the multipath traces split off from the nonoscillatory ducted trace. Effects of relaxing the simplifying assumptions of this analysis (vertical duct direction, isotropy, cylindrical symmetry of the duct, etc.) are discussed. (auth)

25223 RESONANT VIBRATION OF THE MAGNETOSPHERE OBSERVED FROM EXPLORER 26. Sonnerup, B. U. Oe. (Dartmouth Coll., Hanover, N. H.); Cahill, L. J. Jr.; Davis, L. R. J. Geophys. Res., 74: 2276-88(May 1, 1969).

A set of large-amplitude pulsations in magnetic-field magnitude and proton fluxes (E > 98 keV) observed by Explorer 26 in connection with a bay event during the magnetic storm of April 18, 1965, were examined in detail. The peak-to-peak amplitude was about 40 γ and the period about 300 sec. These pulsations were such that the field magnitude was high when the proton fluxes were low and vice versa. They were accompanied by field-direction changes corresponding to an elliptical polarization. The observations are compared with four models involving (1) drifting plasma clumps, (2) ripples traveling in longitude on the surface of a particle belt, (3) a particle belt in periodic radial motion, and (4) a particle population sloshing back and forth along the field lines in the acoustic mode. The last of these models is found to be the most attractive one, and its consequences in terms of periodic modulation of the particle energy are examined. The study also indicates that periodic field-aligned currents accompanied the event. (auth)

25224 HIGH-LATITUDE IONIZATION SPIKES OBSERVED BY THE POGO ION CHAMBER EXPERIMENT. McCoy, J. E. (Rice Univ., Houston, Tex.). J. Geophys. Res., 74: 2309-18 (May 1, 1969).

The POGO spacecraft was launched into a low polar orbit October 14, 1965, and carried an ion chamber experiment sensitive to electrons with energies greater than 1 MeV and protons greater than 10 MeV. Ionization "spikes" appearing frequently at high latitudes were studied in detail. These spikes were found to be present near the high-latitude boundary of stably trapped radiation on at least 30% of the satellite passes through this region. Their frequency of occurrence increases markedly with increased magnetic disturbance. Occurrence of those spikes lying just inside the observed boundary of trapping appears to be evenly distributed with respect to local time, but the occurrence of spikes at latitudes outside the region of stable trapping is predominantly in the dawn hemisphere. It is argued that these spikes are the result of injection of high-energy electrons (E ~ 1 MeV) onto field lines near the boundary of trapping and are associated with the electron "islands" reported in the magnetospheric tail by Anderson and others. It is shown that the spatial distribution of spikes as observed by POGO should be expected as a consequence of electron drift, in the post-midnight quadrant, into a region of pseudotrapping. (auth)

25225 SOME CHARACTERISTICS OF NON-TWO-STREAM IRREGULARITIES IN THE EQUATORIAL ELECTROJET. Balsley, Ben B. (Jicamarca Radar Observatory, Lima). J. Geophys. Res., 74: 2333-47(May 1, 1969).

The analysis of vhf radar echoes from electron concentration irregularities in the equatorial electrojet indicate that there are two distinct types of irregularities in the region. One of these has previously been shown to be generated by the two-stream instability mechanism and consists of planar irregularities that travel at the ion–acoustic velocity. The other type of irregularity moves at about the electron-drift velocity and can exist when the electron-drift velocity is insufficient to produce the two-stream-type irregularities. Drift observations of this second type of irregularity show that the electrojet current reverses during nighttime periods, the electron-drift velocity being comparable to that during the day. Additional observations show that these irregularities exist in large patches that move with the same approximate velocity and retain their identity for many seconds. (auth)

25226 AURORAL SUBSTORM ACTIVITY IN RELATION TO STORM SUDDEN COMMENCEMENTS, RING CURRENT EFFECTS, AND ENERGETIC SOLAR PROTONS. Haurwitz, Marion W. (Environmental Science Services Administration, Boulder, Colo.). J. Geophys. Res., 74: 2348-55(May 1, 1969).

The behavior of the auroral electrojet index, AE, is studied in relation to the magnetic storm sudden commencement (ssc), the ring current main phase, and energetic solar protons. When energetic protons are not present near the Earth, AE shows a relatively weak relation to ssc, but is strongly related to storm main phase, preceding the ring current onset by one or two hours. Such a time relation is not consistent with models that picture outer-zone trapped particles as the source for auroral substorms. When energetic proton events are already in progress at the time of an ssc, AE shows a sharp rise at the hour of ssc. This last relationship is interpreted in terms of the trapping of an intense flux of low-energy protons in the sudden commencement shock front. Such fluxes, unobserved by present detectors, are discussed in relation to polar-glow auroras. (auth)

25227 SEMIANNUAL VARIATION OF GEOMAGNETIC DISTURBANCE AND ITS MODULATION OF SHORTER PERIOD VARIATIONS. Shapiro, Ralph (Air Force Cambridge Research Labs., Bedford, Mass.). J. Geophys. Res., 74: 2356-67(May 1, 1969).

By making use of the techniques of power spectrum analysis and simple linear filtering procedures, it is shown that the amplitude of the 27-day variation of the geomagnetic disturbance index Ci is subject to a significant semiannual modulation. It is also shown that there is no amplitude modulation of this component with other periods such as the annual or 11-year period. The semiannual amplitude modulation, however, is also found in variations of Ci for time periods between 27 days and 6 months, and the phase of the modulation is closely locked in phase with that of the 6-month variation of Ci itself. This close agreement between the 6-month variation of Ci and the 6-month amplitude modulation of such components as the 27-day variation forms the basis of a test between the two principal hypotheses that have been proposed to explain the 6-month variation of geomagnetic disturbance; namely, the so-called "axial" and "equinoctial" hypotheses. In the axial hypothesis, the important element is the inclination of the Sun's axis of rotation to the ecliptic plane, whereas the equinoctial hypothesis depends upon the inclination to this plane of the Earth's axis of rotation and its associated dipole magnetic field. The result of the test clearly favors the equinoctial hypothesis. (auth)

25228 CURRENT-VOLTAGE CHARACTERISTICS OF AN ELECTRON-EMITTING SATELLITE IN THE IONOSPHERE. Linson, Lewis M. (Avco-Everett Research Lab., Everett, Mass.). J. Geophys. Res., 74: 2368-75(May 1, 1969).

The limitation on the current that a sphere at a large positive potential ϕ can draw from a surrounding collisionless plasma in a magnetic field is investigated. The model assumes that for $e\phi \gg kT_e$ the ions are excluded from the region of high potential surrounding the sphere. This region increases in size as ϕ increases, thus presenting an increased cross-sectional area through which electrons can be collected from the plasma along magnetic field lines. It is suggested that there is a critical density at which the electron cloud surrounding the positive body is sufficiently turbulent that the electrons are free to diffuse radially across magnetic field lines and thereby reach the sphere. This model yields a saturation current $I \propto \phi/\ln\phi$, which scales directly with the density, thermal velocity, and square of the body size. At high background electron concentrations a space-charge-limited flow model that predicts $I \propto \phi^{3/4}$ is more applicable, whereas the more pessimistic limit of $I \propto \phi^{1/2}$, which follows from the conservation of the single particle constants of motion in time invariant electric and magnetic fields, is appropriate when the background electron concentration is low. (auth)

25229 LATITUDINAL CUTOFF OF VLF SIGNALS IN THE IONOSPHERE. Heyborne, R. L. (Utah State Univ., Logan); Smith, R. L.; Helliwell, R. A. J. Geophys. Res., 74: 2393-7(May 1, 1969).

The polar-orbiting OGO 2 satellite, receiving 18-kHz manmade vlf signals from the ground, shows a latitudinal cutoff of these signals between roughly 50 and 70° invariant latitude. The signal cutoff ranges from 10 to 40 db magnetic field attenuation and is frequently followed by strong noise believed to be auroral hiss. In about half of the cases the vlf signals from the ground again become detectable beyond the region of noise generation. There is a tendency for the cutoff to be more pronounced during the daytime than during nighttime, and the latitude of the cutoff tends to decrease with increasing Kp. Onset of the attenuation effect is sometimes as large as 40 db over a distance as small as a few kilometers. It is concluded that the latitudinal cutoff occurs over the ionospheric rather than the subionospheric portion of the path. (auth)

25230 NIGHTTIME MOLECULAR OXYGEN DENSITIES IN THE 100- TO 130-km REGION FROM SCHUMANN–RUNGE ABSORPTION. Opal, C. B.; Moos, H. W. (Johns Hopkins Univ., Baltimore). J. Geophys. Res., 74: 2398-2401(May 1, 1969).

Absorption by the Schumann–Runge absorption continuum of molecular oxygen was observed on successive far-ultraviolet spectra of a hot star obtained with a rocket-borne telescope and scanning spectrometer. Molecular oxygen densities in the 100- to 130-km region were found by fitting an integrated model atmosphere to the total column densities observed at several altitudes during the descent of the rocket. The density at 120 km was calculated to be 3.2×10^{10} cm^{-3}, in good agreement with recent optical and mass spectrometer measurements. No appreciable diurnal or seasonal variations in temperature-latitude O_2 densities at the 120-km level are apparent. (auth)

25231 A MEASUREMENT OF THE EFFECTIVE RECOMBINATION COEFFICIENT IN THE LOWER IONOSPHERE. Larson, Lee E. (Denison Univ., Granville, Ohio); Houston, R. E. Jr. J. Geophys. Res., 74: 2402-6(May 1, 1969).

Utilizing the charged-particle spectra obtained on a recent Nike–

Tomahawk firing, the production of electrons in the lower ionosphere was calculated. On the same rocket a Faraday rotation experiment measured the electron concentration. The ratio of the electron production to the square of the electron concentration is the effective recombination coefficient, α_{eff}. The results obtained through this technique give a value for α_{eff} of approximately 6×10^{-7} cm^3/sec at 65 km. This value is in reasonable agreement with that cited by other authors. Closer agreement is achieved when recent experimental values of the negative ion ratio are substituted in the earlier work. (auth)

25232 SUPRATHERMAL ELECTRONS IN THE POLAR IONOSPHERE. Maier, E. J. R. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 74: 2421-4(May 1, 1969).

Some observations of the energy distributions of the suprathermal ($5 < E < 200$ eV) electrons in the polar ionosphere are presented. The data were obtained from a transit of Explorer 31 through the polar region on December 16, 1965. (W.D.M.)

25233 LOW-ENERGY ELECTRON PRECIPITATION AT HIGH LATITUDES. Hoffman, R. A. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 74: 2425-32(May 1, 1969).

Data received from the low-energy auroral particle experiment aboard the OGO 4 satellite show that the high-latitude region of low-energy electrons is composed of bursts of electrons, and that this burst region occurs at other local times besides near the noon–midnight meridian. (W.D.M.)

25234 PRODUCTION AND LOSS OF ^{3}He IN THE EARTH'S ATMOSPHERE. Johnson, H. E.; Axford, W. I. (Univ. of California, San Diego, La Jolla). J. Geophys. Res., 74: 2433-8(May 1, 1969).

The problem is to find a production process adequate to account for the observed concentration of ^{3}He in the atmosphere and the calculated losses due to evaporation and nonthermal processes such as the polar wind. This problem has been briefly discussed before by Axford (1969), in this note the problem is examined in greater detail and again the conclusion is reached that the main source of atmospheric ^{3}He appears to be the precipitation of energetic magneotspheric particles, and that these in turn should originate in the solar wind. (W.D.M.)

25235 COMPARISON OF SIMULTANEOUS FORWARD AND BACKSCATTER SOUNDINGS TO VERIFY A PROPOSED FOCUSING MECHANISM OF HF SKY WAVES. Croft, Thomas A.; Washburn, T. W. (Stanford Univ., Calif.). J. Geophys. Res., 74: 2443-6(May 1, 1969).

It has been proposed that ionospheric focusing of hf radio waves often occurs at a maximum of range for a given signal frequency (Croft, 1967). Here recent observations that bolster the conclusions arrived at previously are discussed; no additional conclusions are presented. The new data provide both oblique sounding and oblique backscatter records obtained twelve minutes apart over the same path. (W.D.M.)

25236 EFFECT OF COLLISIONS ON THOMSON SCATTERING WITH UNEQUAL ELECTRON AND ION TEMPERATURES. Seasholtz, R. G.; Tanenbaum, B. S. (Case Western Reserve Univ., Cleveland). J. Geophys. Res., 74: 2271-5(May 1, 1969).

The two-fluid continuum theory of incoherent (Thomson) scattering is extended to include unequal electron and ion temperatures. The backscattered power is shown to be generally less than that found from a collisionless calculation and is dependent on the ion–neutral and electron–neutral collision frequencies when the electron and ion temperatures are not equal. (auth)

25237 THE STRUCTURE OF PLASMA IN EXOSPHERE CLARIFIED BY THE RECENT SATELLITE EXPERIMENTS. Thomas, J. O. (London Univ. Imperial Coll. of Science and Tech., London). Denpa Kenkyusho Kiho, 14: 525-50(Sept. 1968). (In Japanese).

This paper is the summary of five lectures given by Dr. J. O. Thomas of University of London in the Radio Research Laboratory from May 5 to 10, 1966. In order to observe the upper-side conditions of the F2 layer, the observation was planned using the small topside sounder mounted on an artificial satellite. According to the plan, Canada put Alouette I and II in orbit, while U.S.A. put Topside Sounder in orbit, and at present, these satellites are working effectively. The outline of these satellites is described. The method to determine electron density distributions at the true heights using ionograms is explained. The results obtained by Alouette and their descriptions, the valley and peak of electron density in the ionosphere over the polar region, the distributions of electron and ion in the whistler medium, and the plasma resonance observed by Alouette are described. (NSA of Japan)

Low-Temperature Physics

Refer also to abstracts 24419 and 25801.

25238 (BM-RI-7258) EFFECT OF MICROSTRUCTURE ON SUPERCONDUCTIVITY IN THE COLUMBIUM–HAFNIUM SYSTEM. Siemens, R. E.; Oden, L. L.; Deardorff, D. K. (Bureau of Mines, Albany, Oreg. Albany Metallurgy Research Center). May 1969. 29p.

An attempt was made to correlate the variation of structure-sensitive superconducting properties with microstructure in selected Cb–Hf alloys and to compare the experimental results with those predicted by the GLAG theory. Alloys in wire and rod form were evaluated by critical temperature, critical current, magnetization, resistivity measurements, and optical and electron microscopy. In the absence of an external magnetic field, the current carrying capacity of niobium was greatly reduced with addition of up to 85 wt % Hf, but a large increase in I_c occurred for Nb-90 wt % Hf. Favorable I_c–H behavior was observed in cold-drawn alloys containing 25 and 57 wt % Hf. Correspondingly, a maximum in T_c occurred at 10 to 25 and 90 wt % Hf. Four- or five-hour heat treatments at 600°C resulted in maximum I_c values and maximum hysteresis in magnetization. Dislocation pileup, polygonization, and fine precipitates, responsible for flux pinning, are listed in order of their effectiveness as pinning sites. Sites having an average separation of 1,500 to 3,000 Å and a diameter of 1,000 Å or less were most effective in influencing I_c–H and M-H behavior. The resistive critical fields increased smoothly to a maximum of 80 kOe between 60 and 65 wt % Hf. High-field, mixed state, reversible paramagnetism was observed in some alloys; however, the GLAG theory was in good agreement with experimental results for the majority of the composition range studied. (auth)

25239 (BMwF-FBK-68-43) INFLUENCE OF NEUTRON IRRADIATION AT 4.6°K ON THE SUPERCONDUCTING PROPERTIES OF NIOBIUM. Berndt, H.; Kartascheff, N.; Wenzl, H. (Bayerische Akademie der Wissenschaften, Munich (West Germany). Zentralinstitut fuer Tieftemperaturforschung). Sept. 1968. 45p. (In German). Dep.

The magnetization properties and the electrical resistivity of niobium have been studied as a function of neutron irradiation at 4.6°K and subsequent annealing treatment. A magnetic hysteresis with a dominant "peak effect" near H_{c2} was induced by the neutron irradiation. The upper critical field H_{c2} increased linearly with the normal resistivity ρ_n in agreement with theory. The pinning force f_p exerted by the defect clusters on the flux lines reveals a maximum ($f_p \sim 10^{-3}$ dyn/cm) at a dose of $\phi t \sim 3.10^{18}$ neutrons/cm^2. The residual resistivity ρ_n shows a tendency toward saturation with irradiation; the extrapolated saturation value is $\rho_n \sim 3\mu\Omega$cm. (auth)

25240 (UCRL-71538) MAGNETIC FIELD AND FORCE BY FINITE ELEMENT TECHNIQUES. Chargin, Anthony K.; Henning, Carl D. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 27, 1969. 13p. (CONF-690407-7). Dep. CFSTI.

From Symposium on Engineering Problems of Fusion Research, Los Alamos, N. Mex.

In the design of modern superconducting magnets a detailed knowledge of magnetic fields and forces within the conductor bundle is essential for predicting successful magnet operation. The classic equations of electricity and magnetism cannot be practically employed to calculate magnetic field strength and force magnitudes for a conductor bundle of an arbitrary shape. Any magnet configuration can be approximated with a finite number of several fundamental elements. A computer program is used to sum the electric and magnetic effects of all the elements. The technique of selecting the type of element and the number of each is extremely important in obtaining correct results. Errors on the order of 200% are possible with incorrect selection of finite elements. The parameters to consider in numerically approximating a conductor bundle are presented. Relationships of these parameters are developed to aid in optimizing the selection of the type and number of fundamental elements for the desired accuracy. The correlation between the numerical approximation and the experimentally measured magnetic fields in several test magnet configurations has been excellent. (auth)

25241 SUPERCONDUCTORS. Williams, J. E. C. (Massachusetts Inst. of Tech., Cambridge). Mod. Mater., Advan. Develop. Appl., 6: 187-245(1968).

The following subjects are covered: the discovery and development of superconductivity, the origin of superconductivity, materials for superconducting magnets, power applications, computer elements, the superconducting bolometer, frictionless bearings, the high-frequency application of superconductors, and the future of superconductivity. (M.H.R.)

25242 COMMENT ON GRANULAR SUPERCONDUCTORS. Tilley, D. R. (Univ. of Essex, Colchester, Eng.). Phys. Lett., 29A: 11(Mar. 24, 1969).

Starting with a "ball array" model of a granular superconductor, it is shown that, for grain size and temperature lying within certain limits, the order parameter obeys a "dirty limit" Ginzburg–Landau equation. (auth)

25243 HELIUM DRAG IN THE ZERO FIELD LIMIT THEORY OF IMPURITY IN LIQUID ^{4}He. Lobo, R. (Escola Engenharia, San Carlos, Brazil). Phys. Lett., 29A: 33-4(Mar. 24, 1969).

The "phonon-drag" effect is calculated for the mobility of charged impurities in ^{4}He. This effect raises the conductivity and, although for low and high enough temperatures its dependence on T is the same, the coefficients of the expansions are different. (auth)

25244 QUANTIZATION OF THE MAGNETIC FLUX OF SUPERCONDUCTING RINGS AND BOSE CONDENSATION. Sonin, E. B. (Inst. of Semiconductors, Leningrad). Zh. Eksp. Teor. Fiz., 56: 963-74(Mar. 1969). (In Russian).

The dependence of free energy on magnetic flux is set up for a system of charged bosons in a thin superconducting ring. This permits one to obtain the critical value of the magnetic flux below which persistent currents can flow for quantized values of the magnetic flux. The ratio of the lifetime to the relaxation time of the metastable current macrostate can also be estimated. Peculiarities of Bose condensation in a parallelepiped with strongly differing edges are considered in the appendix. A consequence of these peculiarities is that superfluid and superconducting properties, and in particular, quantization of the magnetic flux, may appear at temperatures which are smaller than that of three-dimensional Bose condensation. (auth)

25245 ON THEORY OF PROXIMITY EFFECTS IN SUPERCONDUCTORS. Galaiko, V. P.; Svidzinskii, A. V.; Slyusarev, V. A. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz., 56: 835-40(Mar. 1969). (In Russian).

The Josephson current is calculated for an arbitrary barrier transparency near T_c. The critical current is calculated for a system of two identical superconductors separated by a layer of normal metal. (auth)

25246 SUPERCONDUCTIVITY NEAR A PARAMAGNETIC IMPURITY. Rusinov, A. I. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.), 9: 85-7(Jan. 20, 1969).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma v Redaktsiyu, 9: 146-9(Jan. 20, 1969).

Some results of allowance for the total amplitude of the scattering of the electrons by a magnetic impurity in a superconductor are presented. (M.H.R.)

25247 JOSEPHSON EFFECT IN SUPERCONDUCTING POINT CONTACTS. Aslamazov, L. G.; Larkin, A. I. JETP Lett. (USSR) (Engl. Transl.), 9: 87-91(Jan. 20, 1969).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma v Redaktsiyu, 9: 150-4(Jan. 20, 1969).

It is shown that the point contact of superconducting electrodes has certain properties of a Josephson element; this agrees with the experimental data. In ordinary Josephson elements, the dielectric slab separating the superconductors may contain metallic bridges, each of which is a superconducting contact. The results show that the presence of such bridges does not change qualitatively the picture of the Josephson effect. (M.H.R.)

25248 CRITICAL CURRENTS AND CURRENT DISTRIBUTIONS IN JOSEPHSON JUNCTIONS. Matisoo, J. (IBM Watson Research Center, Yorktown Heights, N. Y.). J. Appl. Phys., 40: 1813-20(Mar. 15, 1969).

The dependence of I_J, the maximum zero-voltage current, on magnetic fields for a series of Josephson junctions of differing size when compared with λ_J, the Josephson penetration depth, is discussed. The experimental results are in excellent agreement with the calculations; in particular, for junctions with $L \gg \lambda_J$, the Meissner effect and overlapping vortex structure are clearly demonstrated. The current density distributions are also shown. Finally, the implications of size dependence for tunneling cryotron devices are discussed. (auth)

25249 AC FIELD-INDUCED FLUX JUMPS IN Nb_3Sn. Gandolfo, David A. (RCA Applied Research, Camden, N. J.); Dubeck, Leroy; Rothwarf, Frederick. J. Appl. Phys., 40: 1809-12 (Mar. 15, 1969).

An ac magnetic field was applied parallel to the surface of a tubular sample of superconducting Nb_3Sn. The frequency and amplitude of the ac field were used to calculate the largest hysteresis power loss per unit surface area, W_s, which could be applied without flux jumping. The values of W_s increased with increasing background dc field. (auth)

25250 FLUX PINNING BY OXIDE-FILM DISTRIBUTIONS IN A TYPE II SUPERCONDUCTOR. McGinley, P. L.; Nethercott, R. B.; Rachinger, W. A. (Monash Univ., Clayton, Victoria). Scr. Met., 3: 197-8(Apr. 1969).

Wire of composition Pb–10 wt % In, made by melting the constituent high-purity elements under argon and subsequent extrusion, was fed into a "Rokide" metal spraying gun operating in air. The oxide-coated powder was collected in a large polythene bag and sieved to produce a range of particle sizes. Magnetization specimens 0.09 × 0.09 × 1.6 in. were pressed under a standard load of 20 ton/in.^{2} in a demountable die. In this state no porosity could be detected microscopically. Annealing for 24 hr at 100°C was adequate to remove the cast structure as the as-sprayed particles. A continuous record of magnetization vs applied field was made using a vibration magnetometer. Typical magnetization curves for samples of various particle sizes are shown. For comparison, the magnetization curve of a bulk annealed polycrystalline specimen of the same composition is shown. The flux-pinning efficacy of the oxide films as compared with that due to grain boundaries is obvious from the marked difference in the magnetization curves. Indeed, the effect of the oxide films far outweighs that of any other metallurgical variable. For instance, removal, by annealing, of the cast structure of the 0.0051" particle diameter specimen caused a change of only 2% in the remanence B_R. (TSS)

25251 TEMPERATURE DEPENDENCE OF UPPER CRITICAL FIELDS FOR CLEAN SUPERCONDUCTORS OF THE SECOND KIND. II. Lueders, Gerhart; Usadel, Klaus-Dieter (Univ., Goettingen, Ger.). Z. Phys., 222: 358-62(1969).

A numerical mistake made in a previous paper is corrected. For specular reflection of electrons by the surface the result now agrees with a result obtained earlier by Ebneth and Tewordt. In order to facilitate a comparison with experimental data the calculation of the ratio $H_{c3}(T)/H_{c2}(T)$ is extended up to terms linear in $(T_c - T)/T_c$ for arbitrary reflection kernels. (auth)

25252 SOME CHARACTERISTICS OF A Nb_3Sn SUPERCONDUCTING SOLENOID. Ogawa, Shinji (Electrotechnical Lab., Tokyo). Denki Shikensho Iho, 32: 1190-4(Dec. 1968). (In Japanese).

The magnetic field vs current relation, field uniformity, and residual field distribution were measured for a Nb_3Sn superconducting solenoid generating a magnetic field intensity of 83.5 kOe at a current of 100 A in a 26.2-mm-diameter bore. The field intensity at a center of the solenoid shows a large hysteresis curve as a function of energizing current. A method of measuring a magnetic field using an oscillating search coil and an electronic integrator is described. The magnetoresistance of Siemens FP15M 20 InSb field sensing elements was measured up to 83.5 kOe and found to be good as a field monitor. (auth)

25253 OBSERVATIONS RELATED TO THE ORDER OF THE LOW-TEMPERATURE STRUCTURAL TRANSFORMATION IN V_3Si AND Nb_3Sn. Mailfert, R. (Cornell Univ., Ithaca, N. Y.); Batterman, B. W.; Hanak, J. J. Phys. Status Solidi, 32: K67-9 (Mar. 1, 1969).

Measurements were made of the volume changes associated with the cubic-to-tetragonal transformation in V_3Si at 21°K and in Nb_3Sn at 43°K. Lattice parameters were also measured. The volume changes were found to be only 0.02 to 0.03%, within experimental uncertainty, in contradiction to King et al. (Phys. Lett., 26A: 77(1967)). The results do not permit a conclusion to be reached on the thermodynamic order of the transformation. (D.L.C.)

25254 AXIAL MAGNETIC FLUX-LINE SYSTEM OF CYLINDRICAL TYPE-II SUPERCONDUCTORS. Essmann, U.; Traeuble, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart. Univ., Stuttgart). Phys. Status Solidi, 32: 337-56(Mar. 1, 1969). (In German).

The extreme cases of the flux line arrangement in real type-II superconductors with high κ are the periodic triangular lattice for high flux-line densities and the flux-line fluid for low flux-line densities. Density and arrangement of the flux lines depend on the specimen radius vector; this is due to the presence of lattice defects in the superconducting material. The observed flux gradients are discussed in terms of a flux-line dislocation theory. The disorder in the flux-line system increases with decreasing flux-line density. The specimens investigated so far show a transition from the flux line lattice to a flux line fluid for flux-line densities $B_{loc} <$ 30 G. This effect is attributed to the interaction between flux lines and pinning centers. The distance between isolated flux lines from the flux line system may be used to estimate the pinning forces in a fairly direct way. (auth)

25255 OBSERVATION OF FLUX DISTRIBUTIONS IN THIN FILM TYPE-I SUPERCONDUCTORS OF VARYING THICKNESS.

Barbee, Troy (Stanford Research Inst., Menlo Park, Calif.). Appl. Phys. Lett., 14: 156-9(Mar. 1, 1969).

The variation of the flux structure with thickness in thin-film type I superconductors in perpendicular fields has been directly observed. As the film thickness decreases, the flux distribution varies from the intermediate-state structure to a mixed-state structure of multiply quantized flux lines. (auth)

25256 FLUCTUATION-CORRECTED GINZBURG–LANDAU EQUATION AND HIGHER-MOMENT RELATIONS. Gunther, L. (Tufts Univ., Medford, Mass.). Phys. Lett., 29A: 102-3(Apr. 7, 1969).

A Ginzburg–Landau equation to third order in the order parameter is derived, in which fluctuations are taken into account. Relations among higher moments of the distribution functional exp $\{-\beta F[\Psi]\}$ are also derived. (auth)

25257 EVAPORATION FROM QUANTUM LIQUIDS. Widom, A. (Northeastern Univ., Boston). Phys. Lett., 29A: 96-7 (Apr. 7, 1969).

The theory of vaporization of ^{4}He atoms from bulk superfluid helium can be constructed in close analogy to tunneling theory in superconductivity. The vapor (an ideal Bose gas) is considered to be in weak interaction with the bulk liquid. The temperature dependence of the evaporation rate is discussed. (M.H.R.)

25258 VISCOSITY MEASUREMENTS OF DILUTE SOLUTIONS OF ^{3}He IN SUPERFLUID ^{4}He BETWEEN 0.1 AND 1.2°K. Webeler, R. W. H.; Allen, G. (Lewis Research Center, Cleveland). Phys. Lett., 29A: 93-4(Apr. 7, 1969).

Viscosity measurements of three dilute solutions of ^{3}He in superfluid ^{4}He were made between 0.1 and 1.2°K for 1.09, 1.57, and 4.67% molar concentrations of ^{3}He. A torsional-crystal technique with low rim velocity was employed. (auth)

25259 MICROWAVE EXCITATION OF PHONONS IN SUPERCONDUCTORS. Cohen, R. W. (RCA Labs., Princeton, N. J.). Phys. Lett., 29A: 85-6(Apr. 7, 1969).

It is shown that the force exerted by an applied electromagnetic field on the ions in a dirty superconductor is reduced from that of the clean case by the ratio of the electron mean free path to the Pippard coherence length. (auth)

25260 DO LONG-RANGE QUANTUM PHASE FLUCTUATIONS INHIBIT SUPERFLUIDITY IN THIN SYSTEMS? Imry, Y. (Cornell Univ., Ithaca, N. Y.). Contract AT(30-1)-3326. Phys. Lett., 29A: 82-3(Apr. 7, 1969).

The change in the phase of the order parameter along a constant-cross-section superconductor carrying a constant high current and having an extensive mean square fluctuation is mathematically treated. This fluctuation should not have outstanding physical effects, which indicates that the concept of ODLRO (Off-Diagonal Long-Range Order) may not apply here. (auth)

25261 PERSISTENT CURRENTS IN DIRTY TWO-BAND SUPERCONDUCTOR. Kalpagiu, M. K.; Moskalenko, V. A. (Mathematics Inst., Kishinev, USSR). Phys. Lett., 29A: 74-5 (Apr. 7, 1969).

The basic equations of the supercurrent equilibrium state of the dirty two-band superconductors are given. An expression for the current density in the limiting case of the large nonmagnetic impurity concentrations at low temperatures is given and discussed. (auth)

25262 FERMI VERSUS BOSE CONDENSATION IN SUPERCONDUCTORS AND LIQUID ^{4}He. Girardeau, M. D. (Univ. of Oregon, Eugene). Phys. Lett., 29A: 64-5(Apr. 7, 1969).

Macroscopic occupation of a single ^{4}He-atom state cannot occur in liquid ^{4}He, whereas a less extreme condensation, shown by Yang to be responsible for superconductivity, can and probably does occur. Feynman's argument for the low phonon spectrum remains valid. (auth)

25263 TRANSITION TEMPERATURE OF SUPERCONDUCTING BINARY ALLOYS. Karaivanov, V. D. (Sofia Univ.). Phys. Lett., 29A: 59-60(Apr. 7, 1969).

Change of the electron–phonon interaction due to the presence of substitutional impurities is shown to increase the superconductor transition temperature. (auth)

25264 FLUCTUATION ROUNDING OF THE SUPERCONDUCTING TRANSITION IN THE THREE-DIMENSIONAL REGIME. Gittleman, J. I.; Cohen, R. W.; Hanak, J. J. (RCA Labs., Princeton, N. J.). Phys. Lett., 29A: 56-7(Apr. 7, 1969).

Excess conductivity due to superconducting fluctuations in the three-dimensional regime was observed in high-resistivity granular films of aluminum and tin and varied as $(T - T_c)^{-\frac{1}{2}}$ for $d \gtrsim \xi(T)$. The coefficient of proportionality exceeded the theoretical value by about 50%. (auth)

25265 INCREASE OF EXCHANGE INTERACTIONS NEAR ^{4}He IMPURITIES IN SOLID ^{3}He. Bernier, M.; Landesman, A. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Solid State Commun., 7: 529-34(Apr. 1969).

NMR experiments were conducted in solid ^{3}He in the bcc phase with small amounts of ^{4}He. The influence of ^{4}He was found to be stronger on the heat capacity of the exchange system than on T_2. These results are accounted for by a simple model assuming an enhancement of exchange interactions between pairs of ^{3}He nuclei neighbors of ^{4}He. (auth) (UK)

25266 EFFECT OF PRESSURE ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF $La_{1-x}Ce_xAl_2$ AND $La_{1-x}Gd_xAl_2$ ALLOYS. Maple, M. B. (Univ. of California, San Diego, La Jolla); Smith, T. F. Solid State Commun., 7: 515-17(Apr. 1969).

It was found that the pressure dependence of the superconducting transition temperature (dT_c/dP) exhibits a marked dependence on Ce concentration in the $La_{1-x}Ce_xAl_2$ system. In the $La_{1-x}Gd_xAl_2$ system dT_c/dP was independent of Gd concentration within the experimental uncertainty. (auth) (UK)

25267 JOSEPHSON EFFECT IN A VERY DIRTY SUPERCONDUCTOR. Golub, A. A. (Mathematics Inst. and Computation Center, Kishinev). Sov. Phys.-Solid State (Engl. Transl.), 10: 2501-2(Apr. 1969).

Translated from Fiz. Tver. Tela, 10: 3160-2(Oct. 1968).

Equations are derived for the amplitude of the Josephson current in a dirty superconductor. The current decreases with increasing concentration of the impurities. (D.L.C.)

25268 EFFECT OF PARAMAGNETIC IMPURITIES ON THE CRITICAL FIELD OF A SUPERCONDUCTOR. Ginzburg, S. L. (Academy of Sciences, Leningrad). Sov. Phys.-Solid State (Engl. Transl.), 10: 2299-2300(Apr. 1969).

Translated from Fiz. Tver. Tela, 10: 2906-8(Oct. 1968).

It is shown that in some cases the introduction of paramagnetic impurities can increase the critical field of a superconductor. (auth)

25269 JOSEPHSON EFFECTS. Petley, B. W. (National Physical Lab., Teddington, Eng.). Contemp. Phys., 10: 139-58 (Mar. 1969).

Experimental work on the Josephson effects is reviewed. These effects occur in both superconductivity and superfluidity. In superconductivity they are found when two superconductors are separated by a thin insulating barrier ($\sim 10^{-9}$ m thick), or connected by a weak link of metal. A supercurrent can flow between the superconductors, and electromagnetic and magnetic fields can interact with this supercurrent. The interactions demonstrate quantum effects in a particularly striking way, have led to a better understanding of the superconducting state, and have also found some interesting applications. (auth) (UK)

25270 SUPERCONDUCTIVITY IN NIOBIUM AND NIOBIUM–TANTALUM ALLOYS. Ikushima, Akira; Mizusaki, Takao (Osaka Univ.). J. Phys. Chem. Solids, 30: 873-9(Apr. 1969).

From magnetization measurements in superconducting Nb and Nb-rich Nb–Ta alloys it was found that the discrepancies between experiment and theory in the upper critical field and two Ginzburg–Landau parameters as a function of temperature in pure Nb are directly related to the anisotropy of the superconducting energy gap, and not to its non-weak coupling nature. Several electronic parameters were deduced from the measurements. The temperature coefficient of the electronic specific heat, γ, as a function of Ta concentration had a peak at several atomic per cent of Ta, whereas the superconducting transition temperature dropped very rapidly from 9.23°K for pure Nb as Ta was added. An estimation of the carrier concentration in Nb showed that all carriers in the normal state probably pass into the superconducting state at sufficiently low temperatures. (auth) (UK)

25271 PARAMAGNETIC IMPURITIES IN SUPERCONDUCTORS WITH OVERLAPPING ENERGY BANDS. Kon, L. Z.; Moskalenko, V. A. (Mathematics Inst., Kishinev). Phys. Status Solidi, 32: 545-9(Apr. 1, 1969).

The influence of paramagnetic impurities on the thermodynamic properties of two-band superconductors at zero and near zero temperatures is investigated. It is shown that due to interband scattering of electrons there is one gap in two-band superconductors with impurities. The extreme cases of low and large impurity concentrations are investigated. In the first limiting case, an increase in the concentration is accompanied by a linear decrease of order parameters. The expression for the energy gap, densities of states near the energy gap, and the specific heat as functions of impurity concentration are given. (auth)

25272 INFLUENCE OF FILM THICKNESS ON dc JOSEPHSON CURRENT. Weihnacht, M. (Institut fuer Elektronik, Dresden). Phys. Status Solidi, 32: K169-72(Apr. 1, 1969).

The conventional equations for the distribution of Josephson current density are $j_T(x) = j_0 \sin \phi(x)$ and $d\phi/dx = 2e/h\ \mu_0 H(\lambda_1 + \lambda_2)$, where $\phi(x)$ is the phase difference of the order parameter across the barrier. It is shown that the equation for $d\phi/dx$ has another form when the superconductors are thin films. The cases of films without and with current are considered, and the results are shown to be thickness-dependent. Equations are also derived for the Josephson penetration depth. (D.L.C.)

25273 MAGNETIC PROPERTIES OF SUPERCONDUCTORS WITH RESONANCE SCATTERING. Takanaka, Kenji; Takano, Fumihiko (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto), 40: 1273-86(Dec. 1968).

Ginzburg–Landau equations are derived for superconductors with resonance scattering near the transition temperature. It is pointed out that the mixing interaction should depend on the magnetic field in order to guarantee the gauge invariance, and that the current arising from this interaction is necessary for the consistency relation between the coefficients of the first and second G–L equations. Using these equations, the upper critical field H_{c2} (T) and the parameter κ are calculated. It is also shown that the effect of the resonance scattering appears through two factors, the change of the state density and of the relaxation time. The former effect makes both H_{c2} and κ smaller, and the effect of the latter depends on the p dependence of the mixing interaction. If this p dependence is neglected, the latter effect is to increase H_{c2} and κ, and overcomes the former effect. (auth)

25274 PERSISTENT FLOW AND POTENTIAL MOTION OF SUPERFLUID HELIUM. Van Alphen, W. M.; De Bruyn Ouboter, R.; Taconis, K. W.; Van Spronsen, E. (Kamerlingh Onnes Laboratorium, Leiden). Physica, 39: 109-22(July 1, 1968).

At velocities lower than the critical one experiments can be performed which demonstrate the purely potential motion of the superfluid component of liquid helium. Two experiments are discussed: one deals with persistent mass transfer, the other concerns the behavior of a Venturi tube in superfluid helium. The experiments were carried out in compressed jeweler's rouge, so that the kinetic energies at subcritical velocities are high enough to be detected. (auth)

25275 INFINITE CONDUCTIVITY OF ORDINARY AND GAPLESS SUPERCONDUCTORS. Hansen, E. Brun (Univ. of Copenhagen). Physica, 39: 271-92(Aug. 1, 1968).

The effect of electron–phonon interaction on a current in a superconductor is discussed. It is shown that the phonons cause an initial decay of the current, but the final equilibrium current is finite. The reason for this is that while one of the electron–phonon scattering processes reduces the current, there is another (the reverse) electron–phonon process increasing the current; equilibrium is reached when these two processes occur at the same rate. The treatment is extended to gapless superconductivity and makes it possible in a simple manner to understand why it is not the existence of an energy gap in the excitation spectrum, but rather the presence of a pair condensate that is crucial for occurrence of infinite conductivity. The theory is used to interpret the reversible momentum exchange between the lattice and electron systems observed in studies of the temperature dependence of persistent currents. (auth)

25276 MAGNETIZATION OF SINGLE-CORE, MULTI-STRAND, AND TWISTED MULTI-STRAND SUPERCONDUCTING COMPOSITE WIRES. Iwasa, Y. (Massachusetts Inst. of Tech., Cambridge). Appl. Phys. Lett., 14: 200-1(Mar. 15, 1969).

Magnetization measurements performed on three types of Nb–Ti superconducting composite wire have shown that twisted multi-strand wire not only is very stable but also has the smallest magnetization and thus is the most suitable for ac applications. (auth)

25277 PRESSURE DEPENDENCE OF THE PHONON SPECTRUM OF Pb FROM TUNNELING MEASUREMENTS. Franck, J. P. (Univ. of Alberta, Edmonton); Keeler, W. J.; Wu, T. M. Solid State Commun., 7: 483-6(Mar. 1, 1969).

The phonon spectrum of strong-coupling superconducting Pb was obtained as a function of pressure from electron-tunneling data. The pressure dependence of the electron–phonon coupling constant λ, and other parameters, shows that Pb tends toward weaker coupling with increasing pressure. (auth)

25278 CALCULATION OF THERMODYNAMIC FUNCTIONS OF ^{3}He–^{4}He SOLUTIONS. Masimov, E. A. (Physical-Technical Inst. of Low Temperatures, Kharkov). Ukr. Fiz. Zh., 14: 166-8(Jan. 1969). (In Russian).

Thermodynamic functions of ^{3}He–^{4}He solutions were calculated using the liquid–vapor diagram obtained by the magnetic resonance method, by means of which it was possible to determine the concentration in the vapor and in the liquid simultaneously. Thermodynamic data of the liquid–vapor diagram of helium isotopes with 44.3% content of helium in liquid form were tabulated and the layer critical temperature was estimated. Data obtained were in good agreement with experimental data. (R.V.J.)

25279 AN UNDERGRADUATE EXPERIMENT DEMONSTRATING FLUX QUANTIZATION AND SUPERCONDUCTIVITY. Collings, Peter J.; Gordon, Joel E. (Amherst Coll., Mass.). Amer. J. Phys., 37: 293-5(Mar. 1969).

A simple current-sensitive detector which can be used at liquid-helium temperatures is described. It employs Josephson tunnelling and can be easily built in an undergraduate laboratory. The detector itself can be used to observe flux quantization and quantum mechanical interference, or if used in a suitable bridge circuit, to investigate superconducting transitions. (auth)

25280 IMPULSE OF A BEAM OF QUANTIZED VORTEX RINGS. Gamota, G.; Barmatz, M. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Lett., 22: 874-6(Apr. 28, 1969).

The impulse of a beam of charged quantized vortex rings was measured as a function of energy, and the impulse was found approximately proportional to the square of the energy as theoretically predicted. This constitutes the most direct detection of vortex rings that does not rely on charged particles bound to them. (auth)

25281 SUPERCONDUCTING BEHAVIOR OF A15 COMPOUNDS. Hein, Robert A. (Naval Research Lab., Washington, D. C.); Cox, John E.; Blaugher, Richard D.; Waterstrat, Richard M. Solid State Commun., 7: 381-4(Feb. 1969).

Superconductivity was discovered in the A15 compounds $V_{1-x}Ni_x$, V_3Pd and $Ta_{85}Pt_{15}$ and a new feature was observed in the T_c vs. e/a correlation for A15 compounds. The anomalously low T_c of V_3Pd is attributed to magnetic interconnections. Critical magnetic field data are presented for Nb_3Os, Cr_3Rh and Cr_3Ir. (auth) (UK)

25282 CRYOTRON-BASED RANDOM-ACCESS MEMORY. Sass, A. R.; Stewart, W. C.; Cosentino, L. S. (RCA Labs., Princeton, N. J.). IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet., MAG-3: 260-7(Sept. 1967).

From 5th International Magnetics Conference and Exhibits, Washington, D. C.

Recent progress in the design of large-capacity cryoelectric random-access memories is described. Three-wire cryoelectric memory cells and the hybrid AB system organization which utilizes coincident-current selection are examined from the standpoint of batch fabrication requirements, redundancy, electrical parameters, tolerances, and noise immunity. The advances that have been made with experimental subsystems are described in relation to previous work, and are shown to place cryoelectrics as a strong contender in the achievement of a system whose capacity is 10^8 bits or larger. (auth)

25283 DIRECT OBSERVATION OF ELECTRON-PAIRING EFFECT IN TYPE-II SUPERCONDUCTORS BY POSITRON ANNIHILATION. Faraci, G.; Spadoni, M. (Univ., Catania, Italy). Phys. Rev. Lett., 22: 928-30(May 5, 1969).

Angular-distribution measurements of the two gammas produced by annihilation of positrons in a type-II superconductor (Nb_3Sn) were performed to detect the superconducting smearing effect on the electrons momentum distribution function. The results give, for the first time, a direct experimental evidence of the redistribution of K-space states at the superconducting transition. (auth)

Plasma and Thermonuclear Physics

Confinement and Heating

25284 (AD-678637) PLASMA HEATING BY STRONG SHOCK WAVES. Report No. 39. Gross, Robert A.; Miller, Bennett (Columbia Univ., New York. Plasma Lab.). Sept. 1968. Contract AF49(638)-1634. 122p. (AFOSR-68-2681). CFSTI.

The technology of electromagnetic devices which produce very high-speed shock waves is described. The theory of strong shock waves is summarized, and pressure driven shock tube theory and performance is briefly reviewed. The theory and technology of capacitor-bank energy storage systems and auxiliary components such as switches, power supplies, cables, dielectric materials, etc., used with electromagnetic shock tubes are described. The performance of some completed systems together with some experimental results on strong shock waves is presented. (auth) (USGRDR)

25285 TRANSFER PROCESSES IN TOROIDAL MAGNETIC TRAPS. Kovrizhnykh, L. M. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 56: 877-91(Mar. 1969). (In Russian).

Expressions are presented for the particle and energy fluxes across the magnetic field in toroidal magnetic traps of various types (Tokamak, levitron, stellarator, pinched toroid). A totally as well as weakly ionized plasma is considered. From the expressions obtained it follows that toroidality leads, for a sufficiently small collision frequency, to an appreciable increase of the diffusion and thermal conductivity coefficients as compared to the direct systems (corresponding to the value $\delta = r/R = 0$). It is found that for axially nonsymmetric systems (stellarator, pinched toroid) a parameter region exists (low collision frequencies or sufficiently strong electric fields) in which the transfer coefficients in general are independent of the magnetic field strength and pronouncedly (by several orders of magnitude) exceed the respective values calculated, without taking into account toroidality. (auth)

25286 HEATING OF PLASMA ELECTRONS AT THE ELECTRON CYCLOTRON FREQUENCY IN A NONUNIFORM MAGNETIC FIELD. Akulina, D. K.; Bykov, A. P.; Grebenshchikov, S. E.; Ivanov, A. V.; Nechaev, Yu. I.; Sbitnikova, I. S.; Shpigel, I. S. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 56: 721-9(Mar. 1969). (In Russian).

Results of experiments on electron cyclotron heating of a plasma in a stellarator are presented. Conditions of absorption, the uhf energy attenuation length, and plasma lifetime as a function of magnetic field strength and applied uhf energy are investigated. It is shown that the lifetime of the plasma is inversely proportional to the amount of uhf energy absorbed. (auth)

25287 PRELIMINARY EXPERIMENT ON THE PLASMA CONFINEMENT IN THE HELIOTRON P FIELD. II. Mohri, Akihiro; Matsuda, Shinzaburo (Kyoto Univ.). Kakuyugo Kenkyu, 22: 277-95(Mar. 1969). (In Japanese).

The plasma produced by a coaxial plasma gun is axially injected into a magnetic field having the property of minimum average B. This field is generated by the superposition of an usual mirror field upon the field produced by a current-carrying ring placed on the midplane of the mirror field. The injected plasma after 250 μsec from the injection is quiescent with density fluctuation of 10^{-2} or less, though the drift-wave instability exists at the plasma periphery, where the density gradient is fairly steep. The frequency spectrum of the instability has a peak at about 22 kHz and its perpendicular wave length is about 2 cm. By inserting a glass cylinder just inside the ring, the above field becomes the Heliotron C-type field. The plasma injected into this field is quite noisy and it decays faster than the plasma in the minimum average B field. (NSA of Japan)

25288 COMMENT ON THE MODEL OF GORMAN ET AL FOR PLASMA CONFINEMENT TIME IN STELLARATORS. Ohkawa, T.; Jensen, T. H. (Gulf General Atomic, Inc., San Diego, Calif.). Phys. Rev. Lett., 22: 922-3(May 5, 1969).

A model for plasma loss in stellarators is proposed. In this model the plasma loss is assumed to be due to turbulent transport across the magnetic field instead of the classical process proposed by Gorman et al. Both models give the same expression for confinement times. (auth)

25289 FLUCTUATIONS AND PARTICLE LOSS IN OHMIC-HEATED DISCHARGES IN THE MODEL C STELLARATOR. Young, Kenneth Moir. Princeton, N. J., Princeton Univ., 1968. 72p.

Thesis.

The instabilities and loss mechanisms in ohmically heated discharges in the C stellarator are investigated. The plasmas can vary from being collisionless to highly collisional in the sense that the electron mean free path can be varied from about five times the axial machine length down to less than one-hundredth of the length. Low-frequency (~10 kc) fluctuations are observed. The fluctuation properties, such as frequency and wavelengths perpendicular and parallel to the field, have lead to their identification with the current-driven drift instability in the collisionless regime and by a curvature-driven resistive mode in the collisional regime. There is a relatively sharp change from one regime to the other. The theory of the curvature-driven resistive mode has been extended to apply to the experimental conditions and it is found to be weakly ballooning in this case. It is only weakly dependent on shear for the available range of shear. The outward particle flux determined by the correlation of fluctuating density and potential observed by Langmuir probes is inadequate to explain the observed plasma density decay in the collisional regime, where the loss is normally more rapid than the Bohm value. No difference could be found between the flux measured in the straight sections and at the midplane of one U bend, as expected if the ballooning effect is weak. In the collisionless regime, on the other hand, where earlier measurements had shown that the outward flux due to the fluctuations could explain the plasma density decay rate, the confinement times can be improved to about a factor 3 better than the Bohm value at higher values of $l = 3$ rotational transform. This result suggests that the collisionless drift mode is affected by shear. The confinement times were measured by a new technique. The particle loss is measured by grid-electrode collector assemblies mounted in the divertor. The observed confinement times are in good agreement with the density decay times obtained from the microwave interferometer after the interferometer signal has been corrected for influx of neutral particles into the plasma column. (Disser. Abstr.)

Diagnostics

Refer also to abstract 25336.

25290 (AD-679177) PLASMA DIAGNOSTIC TECHNIQUES FOR NONEQUILIBRIUM PLASMAS. Annual Report No. 2, September 1, 1967-October 30, 1968. Bloss, W. H.; Fagen, W. F.; Metz, S.; Schneider, R. T. (Florida Univ., Gainesville. Dept. of Nuclear Engineering Sciences). Oct. 30, 1968. Contract Nonr-580(19). 72p. CFSTI.

A model to explain the gas breakdown was developed and simulated with the aid of an analog computer. Experimental results verified to a large extent the theory and proved the applicability of such a model. Furthermore, several diagnostic methods were studied in order to obtain information about the various plasma parameters. The most sophisticated thereof was scattering of a laser beam by the plasma that yielded time and spatially resolved electron temperatures in the order 10^6 °K. Evaluation of Doppler-broadened, characteristic hydrogen lines made a determination of the gas temperature possible, which turned out to be in the order of 10,000°K and can be assumed equal to the ion temperature. As a useful "side product" the development of two very sensitive detection systems was achieved, namely for low photon and neutron fluxes. The first system has been successfully employed, whereas the latter will be a possible diagnostic tool for planned investigations during the next period. (auth) (USGRDR)

25291 (BMwF-FBK-69-3, pp 1.1-15) CRITICAL SURVEY OF THE METHODS FOR FINDING THE ENERGY SPECTRA OF THE CARRIERS IN PLASMAS BY MEANS OF PROBES. Medicus, G. (Air Force Avionics Lab., Wright-Patterson AFB, Ohio).

According to basic probe theory, simple relations exist between the derivatives of the electron (e-) current to the probe in the e-repulsion range and the energy spectrum of the plasma electrons. In the experiment these relations are marred more or less severely by a host of "secondary effects" (= departures from ideal basic probe model). Most of these secondary effects (such as plasma noise, inhomogeneity and anisotropy of the plasma, collisions, etc.) cause "rounding of the knee" of the probe curve and corresponding rounding in the derivatives. The following secondary effects are discussed qualitatively: (1) the finite amplitude of the modulation signal in second derivative machines, (2) perturbation of the plasma by the probe (especially shifts of plasma potential during the probe cycle), (3) plasma oscillations and noise, (4) inhomogeneity of the work function of the probe, (5) inhomogeneity and/or anisotropy of the plasma, (6) collisions, and (7) surface effects (mentioned only). (auth)

25292 (BMwF-FBK-69-3, pp 4.1-8) DISCUSSION OF THE SECOND DERIVATIVE OF THE PROBE CURVE MEASURED WITH A SPHERICAL LANGMUIR PROBE IN A DISCHARGE IN HELIUM. van Eck, J. (Utrecht Rijksuniversiteit (Netherlands). Instituut voor Theoretische Fysica).

Druyvesteyn's method is used to obtain the energy distribution of electrons in a weakly ionized gas from the second derivative (SD) of the current–voltage curve of a probe. The measurements were performed with a spherical probe in the positive column of a helium discharge. The influence on the SD of the voltage on the guard sleeve, surrounding the quartz-screened probe wire, was measured. A thrustworthy SD curve was found when the guard sleeve was held at space potential. The SD curve, measured in this way, showed an extra increase near space potential over about 1.5 V, which is ascribed to the SD of the ion attraction curve. If one subtracts this contribution it is possible to compare the true SD curve of electrons with calculated energy distribution functions. (auth)

25293 (BMwF-FBK-69-3, pp 9.1-12) ELECTRON ENERGY DISTRIBUTION AND ELECTRON DENSITY IN MOVING STRIATIONS. Hoelscher, J. G. A. (Technische Hogeschool, Eindhoven (Netherlands)).

Langmuir-probe characteristics are measured in eleven different phases of a simple moving striation. From these characteristics the electron energy distribution is determined numerically. The densities of the electrons are calculated by integrating the energy distribution functions. These densities are measured also by the phase shift of a 3-cm electromagnetic wave when

passing through a thin slice of the striation. From these measurements the conclusion must be drawn that within a small distance at the cathode side of the striation most of the electrons are accelerated to an energy of about 15 eV. Apparently over this distance, the time needed for Maxwellization of the electron energy is large in comparison with the transit time of the electrons. (auth)

25294 (BMwF-FBK-69-3, pp 11.1-12) TIME-RESOLVED MEASUREMENTS OF ELECTRON ENERGY DISTRIBUTIONS. Rayment, S. W.; Twiddy, N. D. (York Univ. (England). Dept. of Physics).

A sampling technique was developed that enables time-resolved electron energy distribution measurements to be made by the Langmuir–Druyvesteyn probe method. The results obtained with this method compare favorably with energy distribution measurements obtained previously in stationary striations. The technique is described. (M.O.W.)

25295 90° LASER LIGHT SCATTERING BY A DENSE PLASMA FOCUS. Baconnet, J. P.; Cesari, G.; Coudeville, A.; Watteau, J. P. (CEN de Limeil, Villeneuve-Saint-Georges, France). Phys. Lett., 29A: 19-20(Mar. 24, 1969).

The ruby laser light scattered at 90° by a plasma focus was studied. Signals are detected only before the hot filament formation on the coaxial gun axis and seem to be consistent with a collective plasma behavior. (auth)

25296 PLASMA CONDUCTIVITY MEASUREMENTS USING RF PROBES. Stokes, A. D. (Univ. of Sydney). J. Appl. Phys., 40: 1973-4(Mar. 15, 1969).

The brief discussion points out the difficulties usually encountered in making average conductivity measurements with high-frequency probes. (M.O.W.)

25297 NUMERICALLY CALCULATED PROPERTIES OF A WALL-STABILIZED ELECTRIC ARC. Hodnett, P. F. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). J. Appl. Phys., 40: 1753-8(Mar. 15, 1969).

Some properties of a static electric arc in a circular cylindrical tube are calculated numerically. The radiative influence in the problem is accounted for in a simplified way, and the assumed variations with temperature of the radiated power density, electrical conductivity, and thermal conductivity represent an attempt to cover the whole range of conditions from a weakly ionized gas to a fully ionized gas. With these theoretical expressions for the gas transport properties (i.e., thermal conductivity, etc.), it is possible to calculate the temperature distribution in the arc and, hence, the voltage gradient-current characteristic of the arc and to compare the results with experimental results. The distinct disagreement between these theoretically produced results and experimental results seems to indicate a fundamental discord between the theoretical expressions for the gas-transport properties, and their experimental values, that merits further investigation. The calculations also indicate that the arc is heat-conduction dominated at very high currents (as well as at very low currents). (auth)

25298 ELECTRON DENSITY IN MIXED GAS PLASMAS GENERATED BY FISSION FRAGMENTS. Rees, D. B. (General Motors Corp., Warren, Mich.); Leffert, C. B.; Rose, D. J. J. Appl. Phys., 40: 1884-96(Mar. 15, 1969).

Studies of electron density are reported for a quiescent neon–argon gas plasma generated by fission fragments in the core of a nuclear reactor. Reaction kinetic equations for the various ionic and excited species are solved self-consistently with electron-energy balance equations to yield values of electron density and temperature. It is shown that for containers of diffusion length of about 1.6 mm or greater, there exists a maximum value of electron density at a total gas pressure $p \approx 90$ torr and $[Ar]/[Ne] \approx 10^{-4}$; the dominant ion in this case is the atomic Ar^+ ion. At low values of neutron flux ($\sim 10^{10}$ cm^{-2} sec^{-1}) and electron density ($\sim 10^{10}$ cm^{-3}), the electron temperature is computed to be at or near the gas temperature, but at high values of neutron flux ($\sim 10^{13}$ cm^{-2} sec^{-1}) and electron density ($\sim 10^{12}$ cm^{-3}), the electron temperature is higher than the gas temperature by an important amount (~600°K). Inpile measurements of electron density using microwave techniques are in very good agreement with the theoretical predictions. (auth)

25299 RESONANCE OF A PLANE CAPACITOR CONTAINING INHOMOGENEOUS AND ANISOTROPIC PLASMA. Poularikas, A. D. (Univ. of Rhode Island, Kingston). Electron. Lett., 5: 165(Apr. 1969).

The quasi-static approximate resonance of a plane capacitor partially filled with an inhomogeneous and anisotropic plasma is found, using the calculus of variations. (auth)

25300 MEASUREMENTS OF RADIAL TEMPERATURE DISTRIBUTIONS IN THE H_2 CASCADE ARC UP TO 27,000°K. Steinberger, S. (Technische Hochschule, Munich). Z. Phys., 223: 1-18(1969). (In German).

On a stationary, flowless, and cylindrical hydrogen arc, the radial temperature distributions are measured spectroscopically at a pressure of 1 atm. and up to a current of 150 A. By reducing the diameter of the improved high-power cascade arc chamber to 2 mm, the instabilities of this can be overcome. For the measurements the hydrogen line H_β is used, relative overall intensity of which is derived from the line profile by means of a new method. As the line emission coefficient of H_β has a maximum at approximately 16,000°K, the temperature can be determined using the Lorenz method which yields quite reliable results by normalizing the relative line intensity measured in the arc to that maximum. For the measurement, the "end-on" observation is adopted, since at high currents, i.e., at axial temperatures in the arc of more than 16,000°K, the intensity in the axis of the arc is considerably lower than outside the axis, i.e., in the edge of the arc. To avoid any perspective distortions of the arc image at the slit, a telecentric optical array is used. The error caused by the inhomogeneous layers of the electrode regions is eliminated by determining the intensity difference of H_β on two arcs of very different lengths. For the employed current range, radial temperature profiles in the range of 11,000 to 27,000°K with ionization degrees of up to 98% are obtained. (auth)

25301 SOME MICROWAVE DIAGNOSTIC TECHNIQUES FOR INVESTIGATIONS IN PLASMA PHYSICS. Robinson, L. C. (Sydney Univ.). Inst. Radio Electron. Eng., Aust., Proc., 30: 86-93(Mar. 1969).

Microwaves are used in plasma physics in three ways: as a strongly active agent as in microwave breakdown: as a weakly perturbing agent in the probing of plasmas with microwave beams for measuring such properties as electron density and temperature and as a passive agent in the reception of radiation from plasmas. In gaseous breakdown, charges are caused to oscillate under the influence of high-power radiation fields and to ionize and heat the constituent particles through collisions. High-power, high-frequency oscillators can raise the electrons in a plasma to very high temperatures. Beam–plasma interactions also achieve high temperatures. In the probing of dense laboratory plasmas, millimetre wave interferometric method can measure electron density and temperature and with the use of modulated dipole techniques the spatial distribution of particle density can be determined. The density limitation set upon microwave methods is determined by the condition that the wave frequency must exceed the plasma frequency. Thus, for the high-density plasma of interest to thermonuclear research, the short wavelengths generated by recently developed far-infrared gas lasers are needed as are the modern, fast, free-carrier, photoconductive detectors. Thermal radiation from plasmas can be measured with low-noise receivers to give radiation temperatures. (Australia)

25302 MEASUREMENT OF DENSITIES BY ELECTRON PLASMA WAVE PROPAGATION IN THE PRESENCE OF A STRONG MAGNETIC FIELD. Quemeneur, Agnes; Perceval, Francoise; Etievant, Claude (EURATOM-CEA, Fontenay-aux-Roses, France). Compt. Rend., Ser. B, 268: 139-42(Jan. 13, 1969). (In French).

The electron density profile of a plasma column in a strong field is determined by a new method using the measurement of wave length and that of the potential of electron plasma modes with revolution symmetry (m = 0). (tr-auth)

25303 INTERPRETATION OF EXPERIMENTAL RESULTS OBTAINED BY 8-MM INTERFEROMETRY FOR AN ARGON PLASMA. Bottreau, Andre (Faculte des Sciences de Bordeaux, Talence, France). Compt. Rend., Ser. B, 268: 155-7(Jan. 13, 1969). (In French).

A general method of interpretation of the transmission coefficients of a dielectric sheet with a permittivity gradient is applied for the calculation of argon plasma characteristics, assuming an electron distribution profile of the pseudo-Lorentzian type. (tr-auth)

25304 A 337-μm c-w MASER INTERFEROMETER FOR PLASMA DIAGNOSTICS. Chamberlain, John (National Physical Lab., Teddington, Eng.); Gebbie, H. A.; George, A.; Beynon, J. D. E. J. Plasma Phys., 3: 75-9(Feb. 1969).

It is demonstrated that the electron density n_e and the collision frequency ν in a plasma can be determined by using a 337-μm CW maser as a source for a Mach–Zehnder interferometer containing the plasma in one of its arms. Plasmas having $n_e \sim 10^{19}$ to 10^{21}m^{-3} and $\nu_e \sim 3 \times 10^{10}$ to 3×10^{12}s^{-1} are shown to be particularly suitable for diagnosis in this manner. (auth) (UK)

25305 EXCITATION TEMPERATURE MEASUREMENTS OF INDUCTION-COUPLED ARGON PLASMAS. Ohji, Michio; Akazaki, Masanori; Nakayama, Ryuzo; Ebihara, Kenji; Masuda, Toshihisa (Shinshu Univ., Japan). Rep. Res. Inst. Appl. Mech. (Kyushu Univ.), 16: 1-13(1968).

The relative line-intensity method of measuring excitation temperature was used to find the radial temperature profile in induction-coupled Ar plasmas at reduced (about 1 torr) atmospheric pressures. In the ring discharge the maximum temperature occurred at about 10 mm from the center ($r/R \cong 0.3$); the temperature profile was found to be a ring-like one. Apart from some secondary irregularities and complications, essentially similar features were seen in the column discharge near the coil sections. However, downstream the radial temperature profile turned to a monotonic one with its vertex on the axis of the tube. The maximum temperature of an induction-coupled plasma flow does not necessarily occur on the axis in apparent contrast with the case of dc or ac discharges such as an arc jet. This fact may perhaps be attributed to the skin effect which is well-known in the induction heating of conducting bodies by rf electromagnetic fields. Under these circumstances, the use of the Larenz method for temperature measurements would lead to fallacious results, since it assumes a monotonically decreasing temperature profile in addition to a thermal equilibrium. The measurements were solely concerned with the excitation temperature T_{ex}. At atmospheric pressure T_{ex} may safely be identified with the gas temperature T_g, while at reduced pressures one must be extremely cautious in making a guess on relations between T_{ex} and T_g and/or the electron temperature T_e. (BBB)

Kinetics (General)

Refer also to abstracts 25236 and 25482.

25306 (BMwF-FBK-69-3) SYMPOSIUM ON ONE-PARTICLE DISTRIBUTION FUNCTIONS IN PLASMAS, MARBURG, GERMANY, 25–28 AUGUST 1968. Fischer, M.; Wiesemann, K. (eds.) (Bundesministerium fuer Wissenschaftliche Forschung, Bad Godesberg (West Germany)). Jan. 1969. 331p. (CONF-680830). Dep.

Separate abstracts were prepared for twenty papers. One remaining paper appeared previously in NSA 23:10630 and the remaining paper appears only as an abstract. (M.O.W.)

For abstracts of individual papers see: 25131, 25291–25294, 25307, 25317–25320, 25335–25343, and 25365.

25307 (BMwF-FBK-69-3, pp 10.1-12) ELECTRON ENERGY DISTRIBUTIONS IN A NEON DIFFUSION COLUMN WITH STATIONARY STRIATIONS. Saggau, B.; Eberle, R. (Stuttgart Univ. (West Germany). Institut fuer Gasentladungstechnik und Photoelektronik).

In a low-current diffusion column, defined by the fact that the mean free path of the electrons is considerably smaller than the tube radius, stationary striations appear at the cathode side of the positive column. Calculations, made under the assumption of Maxwellian energy distribution of the electrons, deliver results that are not in good agreement with experimental values. In particular, the calculations do not agree with measurements of Penning (1926), who found that the potential over one stria is approximately equal to an excitation potential of the gas used, and is not a continuous function of pressure and discharge current, for instance. Because of the fact that in such plasmas the relaxation length of the electrons is generally much greater than the striation wave length, it is possible that in this case the electron energy distributions are not Maxwellian. The mean electron energy describes approximately a sawtooth function over one stria having a maximum energy equal to the effective excitation energy of the gas. In a neon diffusion column, measurements of the electron energy distribution are made in the region of stationary striations. They verify the theoretical conceptions. (auth)

25308 SYDNEY UNIVERSITY STUDIES OF MHD SHOCK WAVES IN LABORATORY PLASMAS. Watson-Munro, C. N. (Univ. of Sydney). At. Energy Aust., 12: 24-35(Jan. 1969).

The following three areas of research are discussed: (1) characteristics of ionizing shock waves propagating in neutral gas; (2) properties of the plasma behind the shock waves; and (3) characteristics of large-amplitude Alfvén waves propagating in a highly ionized plasma. (M.O.W.)

25309 SHOCK DEVELOPMENT IN AN ELECTROTHERMAL SHOCK TUBE. Campbell, B.; George, D. W.; Messerle, H. K. (Sydney Univ.). Aust. J. Phys., 22: 23-41(Feb. 1969).

The nature of the electrically energized, i.e., electrothermal, shock tube is discussed. It is shown that its performance simulates that of a mechanical shock tube with a hot driver but with a turbulent or unstable driver-shock interface. (Australia)

25310 SPECTRUM OF CHERENKOV RADIATION IN A WARM ANISOTROPIC PLASMA. Seshadri, S. R. (Univ. of Wisconsin, Madison). Int. J. Electron., 25: 401-16(Nov. 1968).

The Cherenkov radiation emitted by a point charge in uniform motion along the external magnetostatic field in a warm anisotropic plasma is considered. In general, three modes are found to be excited and their frequency ranges of propagation are determined. The directions of the wave normal and the Cherenkov ray are also evaluated. For some typical parameters of interest numerical results of the radial phase velocity, the radial propagation coefficient, the wave normal and the Cherenkov ray directions are given for all the modes as a function of frequency. (auth) (UK)

25311 RELATIVE DIFFUSION AND RECOMBINATION LOSSES IN NEGATIVE GLOWS. Emeleus, K. G. (Queen's Univ., Belfast). Proc. Roy. Irish Acad., Sect. A, 67: No. 4, 39-46 (Mar. 21, 1969).

Data for electron–positive ion recombination coefficients, ion mobilities and electron temperatures and concentration contours in negative glows are used to estimate the relative importance of diffusion and recombination losses for discharges in the 1- to 20-torr pressure range. Diffusion predominates for concentrations below about 10^{10} cm^{-3}. For higher concentrations, depending in detail on the discharge, dissociative or collisional radiative recombination may predominate over diffusion. Hollow cathodes present special problems. More discharge data are needed, particularly for molecular gases, to decide a number of outstanding points. (auth) (UK)

25312 OBSERVATION OF FIRST-ORDER ION ENERGY DISTRIBUTION IN ION-ACOUSTIC WAVES. Ikezi, H.; Taylor, R. J. (Univ. of California, Los Angeles). Phys. Rev. Lett., 22: 923-5(May 5, 1969).

The perturbed part of the ion distribution function is observed experimentally, when an ion–acoustic wave is excited in a plasma. (auth)

Kinetics (Experimental)

25313 (AD-674615) INVESTIGATION OF ACCELERATION MECHANISMS IN MPD ACCELERATORS. Interim Technical Report, December 1, 1966–November 30, 1967. Malliaris, A. C. (Avco Corp., Wilmington, Mass. Avco Space Systems Div.). Apr. 1968. Contract F33615-67-C-1209. 83p. (AVSSD-0044-68-CR); ARL-68-0078). CFSTI.

Results are reported from two major phases of this program: (a) consistency tests of induction velometry and determination of radial profiles of the flow velocity, and (b) determination of electric current distribution in the MPD accelerator. The consistency tests are basically aimed at verifying experimentally the validity of the basic relation in induction velometry. Then, a technique based on induction velometry is developed, analyzed, and applied to the determination of radial profiles of the flow velocity. This technique requires probing of the motionally induced potential versus the radius with adequate radial resolution. From such measurements, the radial profiles are determined by a method based on small but finite differences. Many examples are presented and analyzed. The errors of the method are also discussed. The electric current distribution in the accelerator and the nature of the discharge were investigated with sufficient spatial and temporal resolution, using appropriately arranged, floating electrostatic probes. The experimental conditions here were extended over very wide ranges, namely: gases H_2, D_2, He, NH_3, N_2, and Ar at flow rates ranging from 0.005 to 0.250 gm/sec, currents from 200 to 2000 A, and externally applied B fields from 0 to 2500 gauss. (auth) (USGRDR)

25314 (AD-678093) THE INTERACTION OF PLASMOIDS WITH MAGNETIC FIELDS. Final Report (Volume 1), June 1, 1967–May 14, 1968. Zorskie, Joseph; Bostick, Winston H. (Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics). Aug. 1, 1968. Contract F19628-67-C-0265. 125p. (SIT-P-225; AFCRL-68-0405). CFSTI.

Plasmas from small button-type sources are investigated. The temperature, velocity peak density, and total mass are determined. The mechanisms of production of this plasma are discussed. The plasma is directed transversely across homogeneous magnetic fields and the subsequent interaction is studied. The movement and configuration of the plasma both across and along the field lines, and the dependence on plasma ion mass and magnetic field strength, are determined. Internal plasma structure is probed and internal plasma motion (rigid motion) is confirmed. Theoretical work on plasma vortices is reviewed and compared to the experiment. Evidence from a Plasma Camera is presented which indicated a preferred direction for the growth of plasma protuberances. (auth) (USGRDR)

25315 (AD-678094) A STUDY OF THE DYNAMIC INTERACTION OF A PLASMOID WITH A MAGNETOSTATIC FIELD GRADIENT FROM AN AXIAL CURRENT. Final Report (Volume 2), June 1, 1967–May 14, 1968. Deshmukh, Ashok; Bostick, Winston H. (Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics). Aug. 1, 1968. Contract F19628-67-C-0265. 97p. (SIT-P-226; AFCRL-68-0406). CFSTI.

The dynamic behavior of a plasmoid in a magnetostatic field having a gradient is investigated. The plasmoid is produced by a Bostick-type twin-electrode button source and the azimuthally symmetric magnetostatic field with a 1/r dependence is produced by an axial current of up to 48 kA. The motion of such a plasmoid, projected in the transverse-to-B plane and in the direction of increasing field, is studied. The plasmoid motion is resolved into a motion in the transverse-to-B plane, and a motion along the field lines. The experimental observations reveal that in the transverse plane the plasmoid penetrates across the field lines while experiencing radial deceleration in its bulk (fluid) velocity, and a drift along the axial direction. The radial component of the fluid velocity of this plasma eventually reduces to zero at a turning point; the plasmoid then reverses its radial direction of motion and travels away from the axial current. Concurrently, the plasma spreads along the azimuthal field lines and drifts axially in the direction opposite to that of the axial drift of the plasma in the transverse plane. This plasma also forms a plasma-field interface cavity surrounding the axial current, and its boundary lies at the radial position of the turning point of the trajectory of the plasma in the transverse plane. (auth) (USGRDR)

25316 (AD-678097) SHOCK TUBE STUDIES OF IONIZED GASES. Final Report (Volume 3), June 1, 1967–May 14, 1968. Besse, Arthur L.; Shuchatowitz, Joshua; Tatarian, Albert (Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics). Aug. 1968. Contract F19628-67-C-0265. 38p. (SIT-P-227; AFCRL-68-0529). CFSTI.

A 6-inch arc-driven shock tube was used to study shocks in noble gases. To facilitate the work, improvements both in the basic shock tube and in the instrumentation were made. The boundary layers, stability, and other characteristics of hot ionized samples generated by the shocks were studied experimentally in detail. Certain stability calculations were made, the electron beam apparatus (for plasma diagnosis) was improved but not perfected, and a study of light scattering techniques was made. (auth) (USGRDR)

25317 (BMwF-FBK-69-3, pp 5.1-8) ELECTRON ENERGY DISTRIBUTION FUNCTION IN A HIGH-FREQUENCY DISCHARGE. Eidmann, K. (Marburg Univ. (West Germany). Physikalisches Institut).

Measurements of the electron distribution function are made in an argon ring discharge by using the Druyvesteyn method. The results indicate Maxwellian energy distributions with slight deviations at energies greater than about the excitation energy. The measurements are compared with calculations of distribution functions by Rother and Wojaczek. Finally measured values of the mean electron energy are presented over a wider range of parameters of the discharge and discussed. (auth)

25318 (BMwF-FBK-69-3, pp 7.1-9) ELECTRON ENERGY DISTRIBUTION FUNCTIONS IN GRID REGION OF THREE-ELECTRODE HYDROGEN ARC. Trewsdale, J. M. (York Univ. (England). Dept. of Physics).

Plasma regions close to a single-aperture grid in a low voltage hydrogen arc were studied using a fast-recording Langmuir-probe technique. Measurements of both the normal characteristic and its second derivative were made, allowing computation of both the electron density and energy distribution function. The effects occurring at a single grid aperture in hydrogen were examined in an effort to determine the influence of this region on the behavior of devices of the thyratron type. (M.O.W.)

25319 (BMwF-FBK-69-3, pp 8.1-11) INFLUENCE OF A DIAPHRAGM ON ELECTRON DISTRIBUTION FUNCTION IN GAS-DISCHARGE PLASMA. Wiesemann, K. (Marburg Univ. (West Germany). Physikalisches Institut).

The electron distribution function is measured in a gas discharge constricted by a diaphragm. In the cathode side of the diaphragm a sheath is formed which accelerates the electrons toward the aperture. On the anode side of the diaphragm a beam of fast electrons is found. Comparison of the density of the fast electrons upon the distance from the diaphragm measured in discharges in helium and xenon with calculations based on a simple model for the accelerated electrons shows the influence of the radial electric field and of the collisions between the electrons and the gas atoms. (auth)

25320 (BMwF-FBK-69-3, pp 19.1-19) ION-BEAM INTERACTION WITH A BOUNDED ELECTRON PLASMA. Brakenhoff, G. J.; Baan, A.; Kistemaker, J. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atom en Molecuulfysica).

The applicability of cold-beam plasma theory to the ion beam–plasma interaction is tested. It is found that, when effects of finite dimensions of beam and plasma are taken into account, a good agreement with experiment in predicted growth rate and interaction frequency is reached. The experiment is carried out in a plasma ($n_e = 1 \times 10^7$ cm^{-3}) produced by a slowly diverging 20-keV H_2^+ ion beam ($n_{pb} = 2.5 \times 10^6$ cm^{-3}). Rf signal growth along the beam is observed. Electron density is measured from the dispersion of propagated waves. (auth)

25321 AC DISCHARGES BETWEEN METALLIC DIELECTRIC ELECTRODES IN HELIUM. Bartnikas, R. (Northern Electric Co. Ltd., Ottawa). J. Appl. Phys., 40: 1974-6(Mar. 15, 1969).

Stainless steel electrodes were employed; the dielectric electrode was formed by molding a 0.38-mm layer of polyvinyl chloride (PVC) onto the grounded electrode surface. The gap was energized by a 60-Hz source through a series ionization-free capacitor of 40 pF; this series combination was in turn shunted by an ionization-free capacitor of 3000 pF. The discharge sequence was studied by observing the voltage waveforms across the discharging electrodes using a suitable capacitative voltage divider. The major impurities in the helium gas were hydrogen (20 ppM), neon (15 ppM), oxygen (2 ppM), and nitrogen (2 ppM). The observed voltage waveforms are discussed. (M.O.W.)

25322 EXCITATION OF ELECTROMAGNETIC WAVES OF THE WHISTLER MODES DURING INTERACTION OF AN ELECTRON BEAM. Karkhov, A. N. Zh. Eksp. Teor. Fiz., 56: 792-800(Mar. 1969). (In Russian).

Results are presented of an experimental investigation of the oscillation spectrum produced by an electron beam in a plasma confined by a magnetic field. It is shown that, under conditions when the plasma electron frequency $\omega_{\theta e}$ is greater than the electron cyclotron frequency ω_{He}, electromagnetic waves of the whistler mode are most intensively excited, their frequencies being lower than the electron cyclotron frequency ω_{He} or its harmonics. A correlation between the intensity of these waves and that of the hard x radiation produced by the electrons accelerated in the plasma is observed. (auth)

25323 "TRANSPARENCY" EFFECT IN A PLASMA PRODUCED BY LASER PULSES. Generalov, N. A.; Kozlov, G. I.; Raizer, Yu. P. (Inst. of Mechanics Problems, Moscow). Zh. Eksp. Teor. Fiz., 56: 789-91(Mar. 1969). (In Russian).

The results of measurement of absorption of laser radiation in a plasma are presented. It is shown that for radiation fluxes of 10^2 to 10^3 MW/cm^2 the absorptivity of a xenon plasma is appreciably smaller than at low intensities. The effect is probably due to a rapid decrease of the population of the upper atomic levels from ionization of the excited atoms by electrons and laser quanta under such conditions, when excitation of the atoms from the ground state is a much slower process. (auth)

25324 INTERACTION OF PLASMA CLUSTERS WITH AN AXIALLY SYMMETRIC MAGNETIC FIELD. Hynecek, J. (Technical Univ., Podebrady, Czech.). Czech. J. Phys., 19: 470-6 (1969).

Measurements were made of the magnetic flux of a probe coil excited by a plasma cluster, moving in an axially symmetric magnetic field. The effective diamagnetic current, inductance and resistance of the cluster are derived from the dependence of the measured flux on the distance between the standard coil and the coil forming the magnetic field, as well as from the estimated main dimensions of the cluster. (auth)

25325 SPECTRUM EMITTED FROM SODIUM-SEEDED PLASMAS. Yokota, Toshiaki (Hiroshima Univ.). J. Sci. Hiroshima Univ., Ser. A-II: 32: 29-32(Apr. 1968).

The impurity spectra irradiated by extremely high-temperature plasmas seeded with metallic impurities were studied. Na-seeded shock waves of Mach number 10 to 15 were produced in various gases under the conditions that the initial gas pressure was 1 to 2 torr and the capacitor voltage was 30 kv. The typical side-on spectrograms emitted from these plasmas are illustrated. Emission spectra from Na-seeded plasmas (Na–He, Na–A, Na–H_2, and Na–N_2 produced with a conical cone-type shock tube were found to be composed of sharp series lines (λλ 6160, 6154, 5151), self-reversed and widely broadened principal series lines (λλ 5896 (D_1), 5890 (D_2)), and broadened diffuse series lines (λλ 5688, 5683). In Na-seeded He plasmas, diffuse series lines of Na were stronger than the other Na lines. The half width of the D line was observed to be as large as 20 to 30 Å. The observed line broadening could not be explained as a simple Stark broadening. (BBB)

25326 INTERACTION OF TWO PLASMA BLOBS IN THE MAGNETIC FIELD OF A DIVERTOR. Zykov, V. G.; Karpukhin, V. I.; Rudnev, N. I.; Tolok, V. T. .(Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh., 14: 59-65(Jan. 1969). (In Russian).

The experiments of plasma injection from coaxial sources through the magnetic gaps of a divertor are described. The trapping of charged particles inside the divertor aperture are investigated. It is shown that for simultaneous injection from two sources the total amount of trapped particles is considerably smaller than that from one source. It is also shown that the reason of particle trapping decrease at the injection from two sources is polarization interaction of plasma fluxes moving across the magnetic field with a hollow plasma cylinder formed in the region of the divertor surface. (auth)

25327 INTERACTION OF PLASMA FLUXES WITH PLASMA CYLINDER IN THE DIVERTOR MAGNETIC FIELD. Zykov, V. G.; Karpukhin, V. I.; Rudnev, N. I.; Tolok, V. T. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh., 14: 75-80(Jan. 1969). (In Russian).

The penetration of plasma fluxes moving across the magnetic field of a divertor inside a hollow plasma cylinder formed near the divertor surface at plasma injection was investigated by electric probes, plasmascope, and the Thomson mass analyzer. It is shown that the heads of the plasma fluxes penetrate inside the divertor aperture and the tail parts of them stagnate at the periphery because of their polarization interaction with the formed plasma cylinder. (auth)

25328 EXCITATION OF ION OSCILLATIONS BY BEAM–PLASMA INTERACTION. Vermeer, Abraham. Delft, Netherlands, Technische Hogeschool, 1968. 121p.
Thesis.

A thin electron beam was injected into a tube filled with a low-pressure gas. Measurements were made of the oscillations occurring in this beam–plasma system. The frequency spectrum of the measured instabilities can be divided into two categories: the high frequency spectrum for which the oscillation frequencies are determined by the electrons, and the low-frequency spectrum for which the influence of the ions dominates. The lf oscillations are examined. (M.O.W.)

25329 ELECTRICAL CONDUCTIVITY OF AN ARGON–POTASSIUM PLASMA AT LOW CURRENT DENSITIES AS A FUNCTION OF THE GAS TEMPERATURE. Schwenn, R.; Brederlow, G.; Salvat, M. (Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys., 10: 1077-99(Dec. 1968).

The electric conductivity of a streaming argon–potassium plasma was measured as a function of the electric current density and compared with calculated values. The gas temperature varied from 1400 to 2400°K, the potassium seed concentration from 0.1 to 0.5%, and the maximum current density was 5 A/cm^2. It was found that the value of the electron temperature at a current density j = 0 is strongly influenced by atom–atom excitation collisions. The unexpectedly high values of the electrical conductivity for current densities between 0 and 0.1 A/cm^2 were due to a surplus of electrons carried from the hotter parts of the apparatus into the measuring channel. Calculations of electron density relaxation effects gave some idea of the efficiency of preionization. For values of j between 0.1 and 0.5 A/cm^2 a contraction of the current in the measuring channel was observed. Hence the maximum in the current–voltage characteristic, not predicted by the theory, can be explained qualitatively. The influence of the gas temperature on the electric conductivity for current densities between 0.5 and 5 A/cm^2 was less than expected from the theory. The deviations, which were probably due to the uncertainties of the cross sections used in the calculations, did not exceed 15%. (auth) (UK)

25330 CORRELATION BETWEEN THE MOTION OF ELECTRON PACKETS AND THE EMISSION OF LIGHT BURSTS IN A MULTIPACTOR DISCHARGE. Hildebrand, J.; Smeulders, P. P. L. A. (EURATOM–FOM, Jutphaas, Netherlands). Physica, 39: 473-6(Aug. 26, 1968).

Electron bunching is a characteristic feature of a multipactor discharge. The motion of electron packets was studied by measuring the photon emission of the residual gas in the discharge chamber with a fast signal-averaging technique. The photon radiation intensity is measured as a function of the phase of the driving rf field. The results are consistent with the theoretically predicted electron-emission phase angles. (auth)

25331 ARC STRUCTURE IN A MAGNETIC ANNULAR DISCHARGE. Workman, J. B. (Avco Everett Research Lab., Everett, Mass.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 7: 512-19(Mar. 1969).

The structure of an arc in a magnetic annular discharge in hydrogen was computed numerically using nonequilibrium, quasi-one-dimensional multicomponent hydrodynamics. The analysis substantiates recent experimental observations of a narrow current and ionization zone near the throat that is distinct from the complicated flow in the supersonic expansion. The numerical results suggest a simple diffusion and heating model for the subsonic portion of the arc. This model gives the important physical processes and permits the development of elementary relations that are useful for estimating parametric behavior. Specifically, formulas are derived giving the scale length of the discharge, fraction ionized, and the relationship between electrical power and flow parameters. Certain constants that are needed by the simple model are deduced by matching the results to the numerical analysis. (auth)

Kinetics (Theoretical)

25332 (AD–678577) ON THE KINETIC THEORY OF PLASMA. Final Report, July 15, 1965–July 15, 1968. Kritz, Arnold H.; Sandri, Guido (Aeronautical Research Associates of Princeton, Inc., N. J.). Contract AF33(615)-1910. 104p. (ARL–68-0136). CFSTI.

In view of difficulties encountered in attempting to develop kinetic theory beyond the lowest-order results, it is of major interest to ascertain whether or not the Bogolyubov expansion method is at fault or whether the complicated physics of three-body effects is the stumbling block. It is shown that Bogolyubov's method fails for a model of kinetic theory with many of the features of the BBGKY hierarchy but lacking, by construction, three-body effects. The failure of Bogolyubov's method can be traced without ambiguity in the model to a failure of the functional assumption in a certain region of phase space in the neighborhood of slow relative motion. A method that overcomes this difficulty was developed and tested successfully with an explicitly soluble case. A kinetic description was developed, suitable to determine the transport properties of a plasma in the presence of moderately strong magnetic fields. For a Lorentz plasma the electron velocity distribution was calculated and the electron–electron contributions to electrical and thermal conductivities were determined explicitly. A descriptive survey of solid-state plasma phenomena is given. The generation of solid-state plasmas, then waves, and instabilities in solid-state plasmas are discussed. (auth) (USGRDR)

25333 (AD–678627) EFFECTS OF NONELASTIC COLLISIONS IN PARTIALLY IONIZED GASES. Shaw, James F. (Stanford Univ., Calif. Inst. for Plasma Research). Aug. 1968. Contracts F44620-68-C-0051; AF49(638)-1695. 150p. (SU-IPR–254; AFOSR–68-2621). CFSTI.

A numerical solution is obtained for the coupled Boltzmann equation and rate equations, including the effects of nonelastic collisions and radiation escape. Specific topics include: the rate equations, the Boltzmann equation, and the equation of radiative transfer; simplification of the Boltzmann equation and rate equations to forms which allow analytical solutions to be found; a numerical solution for the coupled Boltzmann equation and rate equations; solutions for a hydrogen plasma in both steady-state and transient situations; the effects of photon escape and nonelastic collisions in a cesium–argon plasma; discussion of physical systems where the effects of nonelastic collisions are likely to be important. (USGRDR)

25334 (AD–680201) COLLECTIVE EFFECTS AND THE SCATTERING OF ATOMIC BEAMS FROM PLASMAS. Goldstein, Byron (New York Univ., N. Y. Dept. of Physics). Nov. 1968. Contract DAHC04-67-C-0034. 46p. (TR–A–68–1; AROD–4614:13-P). CFSTI.

It has been established that atomic beams are useful diagnostic tools in the study of plasmas. They are well suited for certain measurements of plasma ion velocity distributions, and have been used, through attenuation experiments, to measure plasma densities and temperatures. This paper considers the possibility of extending the application of atomic beams to the detection of collective effects in laboratory plasmas. The incident beam energy, even for thermal beams, may be much greater than the energies which characterize the interacting plasma. This suggests that for a wide class of beam energies a weak binding approximation can be used to describe the scattering. In this paper attention is confined to one such approximation–the impulse approximation. (auth) (USGRDR)

25335 (BMwF-FBK–69-3, pp 2.1-25) ELECTRON VELOCITY DISTRIBUTION FUNCTION IN IONIZED GASES: A SURVEY OF THEORETICAL METHODS AND POSSIBLE COMPARISON WITH EXPERIENCE. Delcroix, J. L.; Peyraud, N. (Paris Univ., Orsay (France). Laboratoire de Physique des Plasmas).

The different theoretical methods of computing the one-particle

distribution functions and some macroscopic quantities are given for the three classes of plasmas: weakly, moderately, and strongly ionized. In the first class, electron–neutral elastic collisions only are considered, after which the theory is completed for optically thin plasmas by including inelastic collisions associated with excitation and de-excitation of molecule rotations and vibrations. In moderately ionized plasmas, electron–electron and electron–neutral elastic collisions only are first discussed; then it is shown how inelastic and superelastic collisions change the "tail" of electronic distribution, the population of the first level and the law of ionization in a plasma optically thick for the first transition (resonance radiation). In strongly ionized plasmas, the runaway electron problem is studied. (auth)

25336 (BMwF-FBK–69-3, pp 6.1-10) MONTE CARLO MODEL OF A HYDROGEN DISCHARGE. Aiken, J. (York Univ. (England). Dept. of Physics).

A Monte Carlo technique was used to study the important processes occurring in a hot-cathode low voltage arc in hydrogen. The electron energy distribution at a fixed point in a plane diode discharge was used as a direct test of the accuracy of each model. (M.O.W.)

25337 (BMwF-FBK–69-3, pp 13.1-14) CALCULATED ELECTRON ENERGY DISTRIBUTION FUNCTIONS IN CESIUM AND HELIUM DISCHARGES. Postma, A. J. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica).

The electron energy distribution functions were calculated for discharges in cesium, helium, and helium–argon mixtures. Processes taken into account were elastic and inelastic electron–atom collisions, electron–ion collisions, and mutual electron collisions. From the energy distribution functions the electron drift velocities and the excitation rates were calculated. For a discharge in cesium vapor the calculated drift velocities are compared with measurements. (auth)

25338 (BMwF-FBK–69-3, pp 14.1-7) RANDOM WALK TOWARDS A SIMPLE STATIONARY ELECTRON ENERGY DISTRIBUTION. de Hoog, F. J. (Technische Hogeschool, Eindhoven (Netherlands)).

The electron energy distribution in Townsend discharges is studied. A brief mathematical analysis is presented. (M.O.W.)

25339 (BMwF-FBK–69-3, pp 15.1-30) LOCALLY MAXWELLIAN DISTRIBUTIONS IN A RELATIVISTIC GAS. Kelly, Don; Margenau, Henry (Yale Univ., New Haven, Conn.).

The possible types of locally Maxwellian distributions are determined for a relativistic gas. In the absence of external forces the number of free parameters is eleven, a reduction by two from the number obtained for the nonrelativistic case. The close correspondence of the relativistic and nonrelativistic solutions reveals which two parameters must be zero. Severe restrictions also are placed on the possible types of forces consistent with local equilibrium and the requirements of special relativity. Special attention is directed to the local equilibria open to a gas of charged particles subject to an electromagnetic field. An explicit solution is obtained for the distribution function of such a gas when the fields are constant. (auth)

25340 (BMwF-FBK–69-3, pp 16.1-17) ENERGY DISTRIBUTION FUNCTION FOR WEAKLY IONIZED GASES. Elkomoss, S. G. (McDonnell Douglas Corp., St. Louis, Mo.).

Considering the steady state-case and including both elastic and inelastic collisions, a much easier method is used to obtain exactly the same two differential equations derived by Holstein for weakly ionized gases in the presence of an applied dc field. The distribution function depends on the momentum transfer cross section Q_D as well as on the excitation cross section Q_h to the different electronic excited states in the case of atomic gases. For the elastic scattering, these two equations give the same solution of the distribution function as that of Morse, Allis, and Lamar. The solution of Allis et al. is used to calculate the energy distribution functions, electron mean energies, drift velocities, and electron temperatures for different values of E/P: 0.1, 0.2, 0.3, ... 1, and 2, 3, ... 10. The strength E of the applied electric field is given in V/cm and the pressure P of the gas in torr. The results are strongly dependent on the data of $Q_D(\epsilon)$, where ϵ is the electron energy in eV. With $Q_D(\epsilon) \propto 1/\epsilon^{\frac{1}{2}}$ for $\epsilon > 40$ eV, the recent data of Frost and Phelps for the momentum transfer cross section give the best agreement with experiment. (auth)

25341 (BMwF-FBK–69-3, pp 17.1-16) COEFFICIENTS OF DYNAMICAL FRICTION AND DIFFUSION IN THE FOKKER–PLANCK EQUATION FOR A TURBULENT PLASMA. Tchen, C. M. (City Coll., New York).

A kinetic equation for a turbulent plasma in a magnetic field is derived in the form of the Fokker–Planck equation. Two methods are used: a mixing-length method and a statistical method based on the Liouville equation. It is shown that the coefficients of dynamic friction and diffusion depend on the spectral functions of turbulent kinetic energy and potential energy. The spectra are analyzed by means of a fluid theory of turbulence, based on the Riemann system for a compressible ion plasma. The spectra and the diffusion are derived for the cases of collision-dominant and collisionless plasmas. The results of diffusion in the velocity space are compared with those of diffusion in the position space. (auth)

25342 (BMwF-FBK–69-3, pp 18.1-24) TRANSPORT COEFFICIENTS IN A PLASMA WITH COLLISIONS BY QUASI-LINEAR APPROXIMATION. Li, Kwok-Leung; Jen, Norman C. (City Coll., New York).

The collective behavior of a fully ionized plasma is described by the Boltzmann's equation with Krook's collision term. A small perturbation on the time-independent background distribution function of an infinite homogeneous plasma gives rise to longitudinal plasma oscillations. Consequently, the plasma diffuses in the velocity space. The approach employed is the quasi-linear theory introduced by Drummond, Pines, Vendenov, Velikhov and Sagdeev, who applied it to collisionless plasma. As the fundamental result, this theory leads to a set of two equations, the "decay equation" describing the Landau damping, and the "diffusion equation" describing the diffusion of the plasma in velocity space. (auth)

25343 (BMwF-FBK–69-3, pp 22.1-17) ION DISTRIBUTION FUNCTION IN A SIMULATED EXPERIMENT ON THE FORMATION OF A SHOCK WAVE. Righetti, G. B.; Enriques, L.; Sciarra, R. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Gas Ionizzati).

A computer-simulated experiment is reported concerning formation and propagation of shock waves in a plasma. The experimental conditions are similar to an earlier-reported experiment on large-amplitude ion waves propagating along the plasma column of a Q machine at different ratios of particle temperatures. The one-dimensional case is studied; electrons are assumed to be governed by the Boltzmann law, and ion sheets are displaced in the self-consistent electric field. As an initial condition, one assumes that there are two regions with uniform but different densities, joined by a region with a linear profile. The propagation of the resulting compression wave is studied at various initial ion temperature and different density ratios. Results indicate that if the ion temperature in the unperturbed plasma is less than the electron temperature, the compression wave propagates with a more-or-less constant slope. The ion particle distribution function is measured in front of and beyond the transition and its time evolution is reported. In the case $T_i/T_e \ll 1$, a double-humped distribution function is observed in front region of the compression wave. (auth)

25344 ION DENSITY IN IONIZING BEAMS. Callebaut, D. K.; Knuyt, G. K. (Univ., Ghent). Phys. Lett., 29A: 72-3 (Apr. 7, 1969).

A general method is given to calculate the density of ions created in ionizing beams. Application to ellipsoidal boundaries (including very long and very broad beams), is simple and yields interesting results. (auth)

25345 DERIVATION OF AN EQUIVALENT DIELECTRIC TENSOR FOR A WARM, DRIFTING, LOSSY, ELECTRON PLASMA. Articolo, George A. (Rutgers-The State Univ., Camden, N. J.). J. Appl. Phys., 40: 1896-1902(Mar. 15, 1969).

The equivalent dielectric tensor for an unbounded, beam–electron plasma system is derived in detail. The plasma model simulates that plasma found in the positive column of low-pressure, weakly ionized discharges. Electron-stream drift, electron–electron thermal interactions, and velocity-dependent electron–neutral collision interactions are included in the model. (auth)

25346 NONLINEAR CONDUCTIVITY IN NONRELATIVISTIC CLASSICAL ELECTRON PLASMAS. Silevitch, M. B.; Golden, K. I. (Brandeis Univ., Waltham, Mass.). Contract 19628-69-C-0074. Phys. Lett., 29A: 90-1(Apr. 7, 1969).

A nonrelativistic magnetic field-free classical electron plasma is perturbed from equilibrium by a small external scalar potential, and the second-order current response and conductivity are calculated. (auth)

25347 POLARIZATION OF NORMAL WAVES AND SYNCHROTRON RADIATION TRANSFER IN A RELATIVISTIC PLASMA. Sazonov, V. N. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 56: 1075-86(Mar. 1969). (In Russian).

The dielectric permeability tensor of a magnetoactive relativ-

istic plasma is calculated for high frequencies of interest from the viewpoint of relativistic electron synchrotron radiation. Polarization of normal waves is determined. In contrast to the case of a nonrelativistic plasma the polarization for a monoenergetic distribution is found to be linear. For a power law energy distribution the polarization may be arbitrary and, in particular, circular. It is pointed out that the latter circumstance should be taken into account in interpreting radio astronomy data. (auth)

25348 CLOUDS-IN-CLOUDS, CLOUDS-IN-CELLS PHYSICS FOR MANY-BODY PLASMA SIMULATION. Birdsall, Charles K.; Fuss, Dieter (Univ. of California, Livermore). Contract AT(11-1)-34. J. Comput. Phys., 3: 494-511(Apr. 1969).

A clouds-interacting-with-clouds, clouds-in-cells method (CIC) is presented for many-body nonlinear plasma problems. Density and force are obtained by assuming that the particles have finite size, are tenuous, and may pass through one another; the particles are thus called clouds. They obey a Coulomb force ($\sim 1/r$ or $1/r^2$) when separated and a linear force ($\sim r$) when overlapping, allowing simple harmonic oscillations at small separation. CIC is contrasted with the zero-size particle and nearest-grid-point approach, ZSP–NGP. CIC appears to have substantially less unwanted noise than ZSP–NGP, and should be more useful in simulating dense plasmas. Initial runs have been encouraging. The methods may find use in other many-body simulations, such as with stars, or with particles in phase space. (auth)

25349 EFFECTS OF MASS TRANSFER PROCESSES AND RESISTANCE FORCES ON THE ELECTRODYNAMIC PLASMA ACCELERATION. Kolesnikov, P. M.; Korotkov, V. A.; Stolovich, N. N. (Inst. of Heat- and Mass Exchange, Minsk). Inzh.-Fiz. Zh., 16: 197-205(Feb. 1969). (In Russian).

The processes of mass transfer due to physical phenomena of recombination of plasma, ambipolar diffusion, and electrode erosion are considered. The effects of the resistance forces dependence in different ways on the parameters of the accelerated plasma are discussed. (auth)

25350 CENTRIFUGAL EFFECTS IN PLASMA ROTATION IN A PLANE HOMOPOLAR DEVICE. Gannitskii, A. I. (Leningrad Polytechnic Inst.). Inzh.-Fiz. Zh., 16: 206-11(Feb. 1969). (In Russian).

The rotation of plasma in a plane gas discharge homopolar device due to the Lorentz force is considered. The effect of the centrifugal forces upon the main motion is taken into account. The results obtained show that this effect may be rather pronounced and greatly change the flow picture. (auth)

25351 BALANCE OF MAGNETIZED PLASMA. Lehnert, B. (Royal Inst. of Tech., Stockholm). Ark. Fys., 38: 499-535(1969).

The particle, momentum, and heat balance of static and rotating plasmas were studied by use of macroscopic equations. In a fully ionized confined plasma the surrounding neutral gas and partially ionized boundary layers will penetrate to a certain depth. For the neutral influx that takes place across the confining field, the depth of penetration and the corresponding energy losses from neutral gas interaction in the plasma become small in a hot high-density plasma with cool boundary regions, but not in a low-density plasma. The plasma outflux along the field lines of an open magnetic bottle produces a wall layer of neutral gas that in its turn, forms a back flux of neutrals being reionized in the plasma. The layer depth becomes very small at high plasma temperatures. Because of the screening of the plasma interior from neutral influx and of the reionization process in the narrow wall layers, the plasma density of an open bottle is expected to decay at a much lower rate than that given by the longitudinal outflux only. This agrees with earlier experimental observations of a rotating plasma and there are reasons to believe that Bohm diffusion does not exist in the experiments. The theoretical analysis of the momentum balance and the experimentally determined free-wheeling times show that only extremely small traces of neutral gas can be present in the interior of a rotating plasma. Coupling with the velocity of a rotating plasma limits the temperature to moderately high values, but temperatures of thermonuclear interest may still be achieved by means of extremely large radial ratios and braking rings that increase the viscous shear heating. The losses from a partially open-ended system containing an isotropic plasma have to be limited to a very low level to realize thermonuclear conditions. A closed system may be provided by ring-current configurations with magnetically screened supports. A well-defined lower limit of the temperature and the power input exists below which a fully ionized plasma cannot be kept in a stationary state. This provides a diagnostic method for the study of plasma confinement at moderately high temperatures. (Sweden)

25352 MICRO-FIELD FLUCTUATIONS IN STABLE NON-EQUILIBRIUM PLASMAS. Bornatici, M.; Engelmann, F. (EURATOM–CNEN, Frascati, Italy). Nuovo Cim., Suppl., 6: 1085-1101(1968).

The spectral distribution of the fluctuations in a stable plasma in the absence of external fields is calculated. This is done using the microscopic description of the plasma. The case of a plasma in thermodynamic equilibrium is treated and the theory of thermal fluctuations is derived. (J.F.P.)

25353 PLASMA FREQUENCY REDUCTION FACTORS FOR SHEET ELECTRON BEAMS. Takemoto, Takeo; Sawada, Ryoka (Hitachi Ltd., Chiba, Japan). Electron. Commun. Jap. (Engl. Transl.), 57B: 45-9(Mar. 1968).

The plasma angular frequency reduction factor for the electron beam is an important parameter that governs design of microwave linear beam tubes using electron beams with long path lengths. This factor has previously been analyzed by detailed computations for axially symmetric beams moving through axially symmetric drift spaces. Analysis of a sheet beam of finite width moving through a rectangular drift space are presented, with the results of computations given graphically. With respect to rectangular drift tubes whose ratios of width to thickness exceed 10, the results show good agreement with the previous results derived for parallel conductors of infinite width. If the filling factor of the beam is extremely small, the reduction factor is independent of the beam thickness for sectional configurations ranging from square through flattened rectangle, and also is only slightly affected by the side walls. If the filling factor of the beam is large, the effect of the side walls is to decrease the reduction factors as the ratio of the width to height of the tube approaches one. One tube to which these results may be applied is the linear beam amplifying klystron which utilizes the sheet beam. (BBB)

25354 EQUATION OF STATE OF FULLY IONIZED QUANTUM PLASMAS. Hoffmann, H. J.; Ebeling, W. (Univ., Rostock, Ger.). Physica, 39: 593-8(Sept. 30, 1968).

Starting from the results of a recently developed quantum statistical theory of low-density electron–ion plasmas in thermal equilibrium, the equation of state is derived for the temperature region 10^6 to 10^8 °K. The formula contains the contribution of the exchange effects, and is exact through order e^6 with regard to the electron–electron and the electron–ion interaction, and through order $\hbar^6$ in the contribution of the ion–ion interaction, respectively. The application of the theory to the electron gas model yields an equation of state that holds good for the low-density electron gas over a wide range of temperatures. The equation of state is compared with a result of DeWitt, who calculated the pressure, exchange effects neglected, up to terms of order e^4. Upon comparison, the considerable contribution of the exchange effects in the region of high temperatures is observed. (auth)

25355 CALCULATION OF NONLINEAR EFFECTS IN LORENTZIAN HOMOGENEOUS AND INHOMOGENEOUS PLASMAS. Jancel, J. (Institut Henri-Poincare, Paris). Nuovo Cim., Suppl., 6: 1329-70(1968). (In French).

Methods of calculating the electron distribution function based on expansions following the successive powers of small parameters that characterize the behavior of a nonlinear plasma are studied. (J.F.P.)

25356 EXCITATION OF OSCILLATIONS IN SURFACE WAVES. Shoucri, M. M.; Kitsenko, A. B. Plasma Phys., 11: 345-55(Apr. 1969).

Surface instabilities at a tangential discontinuity between two media, caused by beam-plasma interaction, in the quasistatic approximation, are investigated. The dispersion relation is derived in the case when $K_x r$ is finite (i.e., when the wavelengths are of the order of the transverse dimensions of the plasmas), for a planar and a cylindrical geometry. The thickness of the transition layer between the two media is assumed to be less than the wavelength. (auth) (UK)

25357 SHOCK-LIKE SOLUTIONS OF THE ELECTROSTATIC VLASOV EQUATION. Montgomery, David; Joyce, Glenn (Univ. of Iowa, Iowa City). J. Plasma Phys., 3: 1-11(Feb. 1969).

It is shown how to construct shock-like time independent solutions of the electrostatic Vlasov and Poisson Equations in one dimension. The positive ions are assumed to be at zero temperature, and the electrostatic potential is assumed to increase monotonically through the shock from zero to a constant value. The most important feature of the solution is a population of trapped electrons in the shocked plasma. In contrast to time-independent solutions based upon fluid equations there is no upper limit on the amplitude of the shock. (auth)

25358 EXTENDED ADIABATIC INVARIANCE. Navarro, L.; Garrido, L. M. (Instituto de Fisica Teorica, Barcelona). Physica, 39: 341-5(Aug. 26, 1968).

A simple proof is presented of the quantum mechanical extended adiabatic invariance. The necessary conditions for its validity are also included. (auth)

25359 CHARACTERISTIC MAGNITUDES OF A TWO-COMPONENT NONISOTHERMAL PLASMA. Martinov, N.; Nikolov, N. (Sofia Univ.). Compt. Rend. Acad. Bulg. Sci., 21: 1157-60 (1968).

The characteristic spatial and temporal magnitude in the nonisothermal electron–ion plasma and the penetration in an lf electric field are studied. This result is obtained by solving a linearized self-consistent equation of the field, on the limiting condition $|e\phi| \ll \theta$, $\theta = \kappa T$, i.e., when the electrostatic energy is considerably smaller than the energy of the thermal random movement, and on the assumption that the plasma is an isothermic quasineutral system. (M.O.W.)

25360 EXACT EXPRESSION FOR LONGITUDINAL DIELECTRIC PERMEABILITY OF QUIESCENT OR TURBULENT PLASMAS. Hatori, Tadatsugu (Tokyo Univ.). J. Phys. Soc. Jap., 26: 1023-35(Apr. 1969).

An exact expression for the longitudinal dielectric permeability is derived, taking into account the effects of fluctuations in either equilibrium or nonequilibrium plasma. The Klimontovich formalism is used in generalizing the expression. Correlations are described by diagrammatic representations. Reductions to approximate expressions are given. (D.L.C.)

25361 BOUND INSTABILITIES OF FINITE LENGTH IN A PLASMA. Olivain, J. (EURATOM–CEA, Fontenay-aux-Roses, France). J. Phys. (Paris), 30: 187-91(Feb.-Mar. 1969). (In French).

A system of two counterstreaming electron beams of finite length, including boundary conditions for both particles and waves, is considered. A mechanism is described for instability with frequencies connected with the transit time of the particles in the configuration. The dispersion relation of these waves is discussed, taking into account the parameters of the system (electron density, interaction length, velocity of the beams). (auth)

25362 STOCHASTIC INVESTIGATION OF THE MOTIONS OF FREE ELECTRONS IN GASES. Bell, Michael Joseph. Princeton, N. J., Princeton Univ., 1968. 119p.

Thesis.

Three related problems involving the motions of free electrons in gases are investigated by the technique of stochastic simulation. The system of fast electrons slowing down in a gas is treated, and the electron collision density obtained, as well as G values for excitation and ionization which are consistent with observation. The method developed is used to investigate the energy deposition of 1-keV electrons slowing down in atomic hydrogen. The motions of free electrons in a gas under the influence of a constant electric field are studied, and the electron collision densities, drift velocities, and diffusion coefficients in He, H_2 and N_2 were obtained. The technique made possible the computation of these transport coefficients as well as several related average values of the stochastic distribution that agree well with experiment for a ratio of electric field strength to pressure ranging from 0.002 to 0.20 V/cm-mm Hg. Finally, the problem of the recombination of electrons and ions in the presence of a neutral gas that acts as a moderator is considered, and the stochastic results compared to analytical solutions based on the diffusion equation and the Fokker–Planck approximation to the Boltzmann equation. The diffusion approximation is found to be valid for electrons only in the case of very large positive ions, as an aerosol, while the Fokker–Planck approximation is found to be an adequate classical description of the recombination process. (Disser. Abstr.)

25363 STRUCTURE OF SHOCK WAVES WITH NONEQUILIBRIUM RADIATION AND IONIZATION. Nelson, Harlan Frederick. Lafayette, Ind., Purdue Univ., 1968. 117p.

Thesis.

The physical processes occurring in the precursor and during the approach to equilibrium behind strong shock waves in argon are theoretically investigated. Shock waves propagating at Mach 24 into cold argon at pressures of 0.2, 1.0 and 10.0 cm Hg are considered. The influence both in the precursor and the relaxation region of different atom–atom rates is investigated. The model includes the chemical ionization rates due to atom–atom and electron–atom collisions. Photoionization, which is responsible for the precursor ionization, is also considered. (TSS) (Disser. Abstr.)

Production

25364 (AD-677296) PLASMA DYNAMICS AND INTERACTION WITH HIGH-FREQUENCY FIELDS. Final Scientific Report, February 1, 1966–February 1, 1968. MacKenzie, K. R. (California Univ., Los Angeles. Dept. of Physics). Apr. 12, 1968. 6p. (AFOSR-68-2184). CFSTI.

Previously the plasmas were produced primarily by feeding high-frequency energy from an oscillator to electrodes in a magnetic field. Recently this effort was de-emphasized in favor of a method for generating the plasma by photoionization. These photons have very high frequencies and energies. The photoionized plasmas have been so fruitful that this phase of the research was expanded considerably. Three independent photoionization facilities are now in operation. The largest was used to confirm a quasi-linear theoretical prediction by Field and Fried of this department, in which a suddenly applied electric field causes a plasma current to increase and then sharply decrease due to the growth of ion–acoustic waves. The agreement between theory and experiment turned out to be extremely good. The second piece of apparatus was used to measure the expansion and diffusion of a plasma column with and without the presence of a longitudinal magnetic field. The third piece of apparatus was designed to examine the behavior of large plasma-density perturbations. (USGRDR)

25365 (BMwF-FBK-69-3, pp 12.1-12) VELOCITY DISTRIBUTION OF PARTICLES IN CONTACT IONIZATION PLASMAS. Hashmi, M.; van der Houven van Oordt, A. J.; Wegrowe, J.-G. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)).

The discrepancy between "equilibrium" theory and experiments in the low-density range of a contact-ionization plasma can be explained by an enhanced recombination at the hot end plates; thermal equilibrium between plasma particles and hot end plates is assumed. Calculations on the basis of an axial particle velocity exceeding the thermal velocity, due to sheath effects, yielding a $j_0 \sim n$ dependence, are presented and compared with experiments. (auth)

25366 PLASMA PRODUCTION BY TIP EXPLOSION OF WIRE ELECTRODE AND SPECTRAL IMAGE. Nakaoke, Norimitsu (Shizuoka Univ., Japan). Kakuyugo Kenkyu, 22: 296-307(Mar. 1969). (In Japanese).

The contact arc discharge of a wire electrode was studied in order to explode wire with a much lower applied voltage than that in general wire explosions. The tip of the wire electrode was gradually exploded in the range of appropriate length, and high-density plasma was produced in air at atmospheric pressure. High-speed framing photographs of the plasma were taken as well as a general time-integrated one. The high-density plasma was stable in the case that polarity of the copper wire electrode was positive. On the contrary, the high-density plasma was unstable in the case of negative polarity, moreover it was found out that the wire was surrounded with lower-density plasma. Spectral-image photographs were taken especially to investigate the spectroscopic space distribution of the lower-density plasma. The image of the ion spectrum of calcium contained in the copper wire had remarkably different characteristics in space distribution and radiation strength from that of copper. (NSA of Japan)

25367 METHOD AND DEVICE FOR THE GENERATION OF BEAMS OF MATTER WITH SHARP SPATIAL COLLIMATION. (to Gesellschaft fuer Kernforschung mbH). British Patent 1,148,900. Apr. 16, 1969. Priority date Nov. 25, 1966, Germany.

The beams are produced in an evacuated vessel where a jet consisting of condensed matter and uncondensed residual gas is generated by expansion of a gas out a nozzle. Such beams may be used to generate high-temperature plasmas by electric discharges. The method and device are described. (M.O.W.)

25368 ON THE EFFECT OF IMPURITIES INTRODUCED DURING THE BREAKDOWN ON THE PERFORMANCE OF A MAGNETICALLY DRIVEN SHOCK TUBE. Chang, C. T.; Mondrup, K. (Danish Atomic Energy Commission Research Establishment, Riso. Technical Univ. of Denmark, Lyngby). Plasma Phys., 10: 1106(Dec. 1968).

Through a proper transformation of variables it is shown that, when the amount of impurities introduced during the breakdown is constant, the main result of the previous work of Chang and Kofoed-Hansen (Plasma Phys., 10: 137(1968)) remains unaltered. (auth) (UK)

Stability

Refer also to abstract 25361.

25369 (AD-679110) OVERSTABLE MODES DUE TO RESISTIVITY GRADIENTS IN CURRENT-CARRYING PLASMA SLAB. Pridmore-Brown, David C. (Aerospace Corp., El

Segundo, Calif.). Sept. 1968. Contract F04701-68-C-200. 15p. (TR-0200(9220-02)-1; SAMSO-TR-68-416). CFSTI.

A preliminary study is made of overstable modes due to resistivity gradients in a current-carrying plasma slab. A restricted set of solutions satisfying a constant pressure assumption is found for the magnetohydrodynamic equations. These solutions turn out to be overstable in a certain range of the resistivity. (auth) (USGRDR)

25370 CONSTRICTIONS IN A FINITE CONDUCTIVITY PLASMA. Rukhadze, A. A.; Triger, S. A. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 56: 1029-36(Mar. 1969). (In Russian).

The problem of appearance of axially symmetric instabilities in a plasma discharge of arbitrary conductivity is solved. Two configurations are investigated: a simple cylindrical discharge (Z pinch) and a discharge with an opposite axial current. Increments of the most dangerous long-wave instabilities disturbing a considerable part of the plasma are found, and it is shown that the multi-mode instability in an infinite-conductivity plasma revealed in Trubnikov's work changes into a single-mode instability with decrease of conductivity. The finite conductivity does not affect the fundamental unstable mode, whereas the higher modes are stabilized by the finite conductivity of the plasma. The present analysis makes it possible to rigorously establish the two approximations employed previously in investigations of stability of plasma discharges, viz., the limiting case of high conductivity and the case of low conductivity of special interest in connection with the use of self-compressed discharges as light sources. The analysis also points to the correctness of such approaches in investigation of spiral and kink modes. (auth)

25371 VLASOV DESCRIPTION OF AN ELECTRON GAS IN A MAGNETIC FIELD. Davidson, Ronald C.; Krall, Nicholas A. (Univ. of Maryland, College Park). Phys. Rev. Lett., 22: 833-7(Apr. 21, 1969).

An algorithm is presented for obtaining electron-gas stability information from neutral-plasma literature. (auth)

25372 EFFECT OF THE LONGITUDINAL DIMENSIONS OF A PLASMA COLUMN ON THE KADOMTSEV–NEDOSPASOV CRITERION FOR EXCITATION OF CURRENT-CONVECTIVE INSTABILITY. Dubovoi, L. V.; Shanskii, V. F. Zh. Eksp. Teor. Fiz., 56: 766-71(Mar. 1969). (In Russian).

The effect of the finite length of a plasma column on the development of Kadomtsev–Nedospasov current-convective instability was studied. The spatial spectrum of the instability harmonics in a restricted plasma was measured. It is shown that when the wavelength of the instability λ is comparable to the longitudinal dimensions of the plasma, the appearance of new regions of stable behavior of the current column should be possible. The experimental results are compared with the theory. (auth)

25373 ELECTROSTATIC INSTABILITIES IN THE TIME MODULATED MAGNETIC FIELD. Teichmann, J. (Inst. of Plasma Physics, Prague). Phys. Lett., 29A: 66-7(Apr. 7, 1969).

The effect of electric and magnetic hf fields on drift-temperature instability of plasma, penetrated in the time-modulated magnetic field, is discussed. (auth)

25374 NUMERICAL SIMULATION OF IONIZATION INSTABILITY. Lengyel, L. L. (Institut fuer Plasmaphysik, Garching, Ger.). Phys. Lett., 29A: 60-1(Apr. 7, 1969).

The possibility of numerical simulation of ionization instability is discussed. A perturbation technique that leads to results that agree well with experimental observations is described. (auth)

25375 FINITE-RESISTIVITY INSTABILITIES OF A SHEET PINCH. Wei, Chau-chin (National Tsing Hua Univ., Taiwan). Chin. J. Phys. (Taiwan), 6: 88-99(Oct. 1968).

An algebraic but general procedure, which is the direct application of semi-group representation, is used to obtain the criteria for instabilities and a simple evaluation of their growth rates is demonstrated for the finite resistive magnetohydrodynamic case. The results are compared qualitatively with other works and the parameter dependence of the gravitational mode agrees fairly well with the computer experiment. (auth)

25376 A VARIATIONAL APPROACH TO THE DYNAMIC STABILITY F HIGH-DENSITY PLASMAS IN MAGNETIC CONTAINMENT DEVICES. Wells, Daniel R.; Norwood, Joseph Jr. (Univ. of Miami, Coral Gables, Fla.). J. Plasma Phys., 3: 21-46(Feb. 1969).

Variational methods are used to determine the structure of dynamically stable plasmoids, the total energy of the plasmoid being varied subject to a set of constraint integrals on the flow. It is demonstrated that the resulting flow structure results in a plasmoid of the type observed experimentally when the angular momentum of the plasmoid is not conserved. This is the collinear vortex structure. New experimental results are presented which demonstrate that the structures observed in mirror-trapping experiments may be of the type predicted by the variational calculation. It is demonstrated that the collinear plasmoid structures can propagate in a surrounding conducting gas as members of a class of nonlinear transverse waves that trap and transport fluid mass. They may also exist as standing waves in a surrounding medium which supports currents and acts as a force-bearing shell. The interaction of the nonlinear transverse waves (plasmoids) with each other and with the magnetic mirror field produces a reversed-field closed configuration. Experimental results are presented which illustrate these effects and show details of the structures. It is also demonstrated that a modification of these solutions that assumes conservation of angular momentum of the plasmoid describes another type of plasma structure which is centered on the magnetic field lines and moves at right angles to the field. This is the field-aligned plasma structure. (auth) (UK)

25377 TEARING MODE INSTABILITY IN THE BESSEL FUNCTION MODEL. Gibson, R. D.; Whiteman, K. J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys., 10: 1101-4(Dec. 1968).

Preliminary to a numerical study of the tearing mode move in diffuse pinches, an example that can be solved analytically is considered, using the Bessel function model that possesses several of the features of interest. A variety of mode numbers and wall positions for the Bessel function model is considered and conditions leading to stability are derived. (UK)

25378 EFFECT OF FINITE PLASMA LENGTH ION CYCLOTRON INSTABILITIES. Kelley, G. G. (Oak Ridge National Lab., Tenn.). Plasma Phys., 10: 1105(Dec. 1968).

The absence of coupling between field and particle at the Doppler-shifted gyrofrequency and the existence of coupling at the gyrofrequency and at even multiples of the Doppler shift imply that particle reflection must be taken into account explicitly in a description of instabilities in which ion streaming is important. Modes with potential maxima at the reflection points and modes with $k_{\parallel} = 0$ are not affected. (auth) (UK)

25379 STABILITY OF A PLASMA WITH LOSS FROM THE ENDS OF AN AXIALLY SYMMETRIC MAGNETIC BOTTLE. Hamada, Shigeo; Sato, Masatomo (Nihon Univ., Tokyo). J. Phys. Soc. Jap., 26: 1036-48(Apr. 1969).

Interchange stability and drift motion of a plasma with unsteady losses are analyzed in a low-β limiting case with the use of ideal hydromagnetic equations. The m-th mode of radial displacement δr_m of the plasma boundary is subject to the equation $\delta\ddot{r}_m - (\dot{S}/V)\delta\dot{r}_m + m(P/V)\delta r_m = 0$, where the dots indicate the time derivatives and the coefficients are some averages of the state of the flow along the entire line of force. The reactive force is due to the Coriolis force on the flowing plasma within a moving flux tube, and the potential force is due to the plasma pressure and the centrifugal force of the flow. Solutions of the equation show that the system is stabilized by the plasma outside the ends, in good agreement with experiments. (auth)

25380 COAXIAL-FLOW STABILIZATION OF AN ALTERNATING-CURRENT PLASMA ARC. Lanzo, Chester D. (Lewis Research Center, Cleveland). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 7: 538-40(Mar. 1969).

An experiment on the feasibility of using coaxial guns of dissimilar gases maintained at uniform parallel and horizontal flow through concentric nozzles to achieve arc stabilization is described. (M.O.W.)

Thermonuclear Processes

Refer also to abstracts 25729, and 25737–25740.

25381 (AD-678506) EXPERIMENTAL STUDY OF THE MK-IA PLASMA NEUTRON SOURCE. Dazey, Mitchell H.; van Paassen, Hugo L. L. (Aerospace Corp., El Segundo, Calif.). Apr. 1968. Contract F04695-67-C-0158. 44p. (TR-0158(3220-50)-3; SAMSO-TR-68-402). CFSTI.

An experimental investigation was carried out to determine the relationships between the significant parameters of an unusual pulsed neutron generator. The device employs a novel paraboloidal electrode geometry and belongs to the general class of plasma "focus" devices in which neutrons are generated by the compression of a dense deuterium plasma. Maximum neutron yields of the order of 10^9 neutrons/shot were obtained using a bank of six 14-μF capacitors at 23 kV for a bank energy of 22 kJ. The parametric variables studied included deuterium gas pressure, bank voltage, anode geometry, and electrode material in the vicinity of

the focus. The neutron and x-ray spectra were measured. (auth) (USGRDR)

25382 (ITF-69-7) EFFECT OF ELECTRON SCREENING ON THERMONUCLEAR REACTIONS UNDER HIGH DENSITIES. Porfir'ev, V. V.; Redkoborodyi, Yu. N. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1969. 30p. Dep.

The effect of electron screening of the Coulomb field of nuclei, which increases the thermonuclear fusion rate, is considered. The effective potential is derived by means of the self-consistent field method based on the Hartree–Fock approximation. The influence of reacting nuclei on distribution of the screening space charge of electrons is taken into consideration. The screening contribution to interaction energy of colliding nuclei depends essentially on the self-energy of the screening electron cloud. The results differ greatly from the results of other authors. (auth)

25383 (LA-4131) NEUTRON BLANKET CALCULATIONS FOR THERMONUCLEAR REACTORS. [PART] II. Bell, George I. (Los Alamos Scientific Lab., N. Mex.). Mar. 11, 1969. Contract W-7405-eng-36. 8p. Dep. CFSTI.

The breeding potentials of various neutron blankets surrounding a pulsed thermonuclear reactor have been calculated using multigroup methods. A basic lithium blanket containing up to 15 vol. % niobium was found to give marginal breeding. For such Nb concentrations the neutron flux depression at Nb resonances should be taken into account in devising multigroup cross sections; this resonance self-shielding increases the triton production by ~10% in the basic blanket. Several modifications of the basic design were found to give improved breeding, in which the ratio of tritons produced to tritons burned, in producing 14-MeV neutrons, is equal to or greater than 1.20. These include (a) replacement of Nb by Mo and Zr, (b) use of lithium enriched in ^{6}Li, and (c) addition of hydrogen to the blanket. The displacement of lithium by beryllium does not appear attractive. Thus, a variety of options are available to obtain satisfactory breeding from a lithium blanket containing substantial amounts of structural material. (auth)

25384 (UCRL-71534) BASEBALL II COIL FORM GEOMETRY AND FABRICATION. Calderon, Manuel O. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 27, 1969. 13p. (CONF-690407-17). Dep. CFSTI.

From Symposium on Engineering Problems of Fusion Research, Los Alamos, N. Mex.

The Alice Baseball II superconducting magnet presented unique problems in the choice of geometry and in the design of a coil structure that would enclose the conductor in a helium environment and resist the large distortion forces. The geometry and the relative size of the coil form in component and assembled state is illustrated and explained. Also discussed are some of the requirements and solutions involved in the selection of fabrication methods and in the choice of materials. Additionally presented are problems that were encountered during the actual production of this large coil form. Closing comments describe the present status of the construction. (auth)

25385 (UCRL-71567) REDESIGNED CONTROLS FOR THE ASTRON MAGNETIC FIELD USING OPERATIONAL AMPLIFIERS. Robinson, Jerry W. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 1, 1969. 10p. (CONF-690407-12). Dep. CFSTI.

From Symposium on Engineering Problems of Fusion Research, Los Alamos, N. Mex.

The Astron machine has undergone several stages of modifications. Each of these changes has required either increased flexibility or increased output from some subsystem. One of the more adaptable subsystems has been the voltage reference scheme used to control the shaping of the main solenoidal field. However, a recent 70% increase in the required number of outputs, from 65 to 110, dictated a major expansion of the reference subsystem. Complete redesign and rebuilding proved to be more advantageous than expansion both in cost and system flexibility. Several factors leading to this conclusion and a description of the resulting system are presented. (auth)

25386 MEASURED ANISOTROPIES OF THE PLASMA-FOCUS NEUTRON EMISSION COMPARED WITH PROPOSED MECHANISMS. Patou, C.; Simonnet, A.; Watteau, J. P. (CEN de Limeil, Villeneuve-Saint-Georges, France). Phys. Lett., 29A: 1-2(Mar. 24, 1969).

Measured energy spectrum and flux anisotropies are better explained by the boiler model except near the discharge axis where unexpected fluxes are observed. (auth)

25387 METHOD AND DEVICE FOR STRIKING AN ELECTRIC ARC BETWEEN TWO ELECTRODES. Langer, Phillipe (to Commissariat a l'Energie Atomique). British Patent 1,148,194. Apr. 10, 1969. Priority date Sept. 16, 1965, France.

A method is described for generating less than 20-nsec electrical pulses of 10 to 20 kV having lengths of 1 to 10 nsec and leading-edge or rise times of less than 0.5 sec. The method is of interest in photography of short-lifetime plasma bursts. (M.O.W.)

25388 DIPOLE CURRENT LEAD FOR A PLASMA CONTAINMENT DEVICE. Hammel, Jay E. (to United States Atomic Energy Commission). U. S. Patent 3,441,775. Apr. 29, 1969.

A device for providing current feed to the inner conductor of a plasma confinement geometry without introducing a field null and corresponding plasma leakage is described. An arm contacts the outside shield of the coaxial lead before it reaches the inner conductor. (AEC)

25389 ION DRAG AND CURRENT PARTITIONING AT THE CATHODE OF A PLASMA ACCELERATOR. Rohatgi, Vijay K.; Aisenberg, Sol (Space Sciences Inc., Waltham, Mass.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 7: 502-6(Mar. 1969).

In order to study the physical processes influencing the performance of plasma accelerators, tangential drag forces at the electrodes of an arc in a transverse magnetic field are measured experimentally. Arc plasmas of 30 to 100 A for copper and molybdenum electrodes in argon and helium are investigated with fields up to 1.5 kG. Larger drag forces are recorded at the cathode than at the anode. About 30 to 45% of the plasma driving force is transferred to the electrode boundaries. These forces depend weakly on the gas pressure in the range 0.2 to 20 torr, decreasing slightly at higher pressures. The drag forces show a complex dependence on the magnetic field and arc current, consisting of a threshold and a saturation effect. The drag threshold depends on the target material and appears to be related to the sputtering threshold. The excess drag measured at the cathode can be used to compute the ion and electron current at the cathode spot. Based upon the saturaged drag-force measurements, the ion current fraction at the cathode is estimated to be about 9 to 10% for various gases and electrodes. (auth)

Wave Phenomena

Refer also to abstract 25312.

25390 (AD-677375) CONTRIBUTION OF NEUTRAL ATOMS TO THE ABSORPTION OF PHOTONS IN PLASMAS. Tsai, H. S.; Akcasu, A. Z.; Osborn, R. K. (Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering). Aug. 1968. Contract DA-31-124-ARO(D)-403. 135p. (AROD-6092:12-P). CFSTI.

The index of refraction and the attenuation coefficient per unit time, as well as per unit length, was obtained for an arbitrary medium using Maxwell's wave theory. Results are expressed in terms of the microscopic currents due to the motion of the particles in the medium. The contribution of the neutral atoms to the absorption of photons in plasmas was investigated by extending Akcasu and Wald's work on absorption due to the inverse bremsstrahlung of electrons in the field of neutral atoms to higher electron temperatures and higher photon energies. This problem was formulated by using plane waves for the electron wave function. In this way an expression was obtained for the absorption of coefficient per unit length due to the above absorption mechanism in terms of the elastic and inelastic electron–atom scattering cross sections allowing the atoms initially to be in any excited state. The absorption coefficient was calculated explicitly for hydrogen atoms; the results are presented graphically as a function of electron temperature and radiation frequency. (auth) (USGRDR)

25391 (AD-677649) WAVES IN PLASMAS. Sturrock, P. A. (Stanford Univ., Calif. Inst. for Plasma Research). May 8, 1968. Contract AF49(638)-1321. 24p. (AFOSR-68-2414). CFSTI.

The subject of waves in plasmas has attracted a great deal of attention from the very beginnings of research into the physical properties of ionized gases. From the point of view of the astrophysicist, this is easily understood. He must interpret the electromagnetic emissions from celestial bodies that are almost always plasmas themselves. Moreover, these signals have propagated through interstellar and possibly intergalactic space where even extremely tenuous plasmas can produce significant effects over the immense path lengths involved. (auth) (USGRDR)

25392 (AD-678350) TRANSVERSE PLASMA WAVE ECHOS. Fried, Burton D.; Olson, Craig (California Univ., Los Angeles. Plasma Physics Group. TRW Systems, Redondo Beach, Calif.). Oct. 1968. Contract Nonr-4756(01). 13p. (R-37). CFSTI.

Transverse plasma echoes can arise from two spatially separated, steady-state excitations, a transverse one at frequency ω_1 and a longitudinal one at frequency ω_2. The theoretical results for the location, polarization, and other characteristics of these echoes, which have frequency $\omega_1 \pm \omega_2$, take into account collective effects, as found from the Vlasov equation. The variety of phenomena involved is much greater than in the case of two longitudinal excitations. (auth) (USGRDR)

25393 (AD–678840) CYCLOTRON ECHO STUDY. Final Report, May 16, 1966–August 31, 1968. Hill, Robert M.; Herrmann, Gabriel F.; Kaplan, Daniel E. (Lockheed Missiles and Space Co., Palo Alto, Calif. Lockheed Palo Alto Research Lab.). Aug. 30, 1968. Contract AF19(628)-5932. 82p. (AFCRL–68-0473). CFSTI.

Cyclotron resonance echoes were explored experimentally and theoretically. The phenomenon is adequately explained in the low-electron-density region $\omega_p \ll \omega_c$ by a model involving the nonlinear loss introduced by the velocity dependence of the electron–neutral particle collision frequency. The effect of electron diffusion is treated formally and qualitative agreement found with experimental results. Quantitative answers on electron energy and momentum relaxation processes should result from careful experimental control of diffusion. For electron densities such that $\omega_p < \text{or} > \omega_c$ the phenomenon is more complex and quantitative results will require a deeper understanding of the resonances which are being excited in the plasma. Reprints of work associated or inspired by this study are included. A second part of this report is a brief survey of echo phenomena, in an attempt to make this effect plausible and to point out its generality in systems made up of collections of resonators. (auth) (USGRDR)

25394 (AD–680407) ELECTROACOUSTIC RESONANCES IN A NONUNIFORM PLASMA. Report No. Scientific-1. Ewald, Harry N. (Sperry Rand Research Center, Sudbury, Mass.). Oct. 1968. Contract F19628-67-C-0096. 25p. (SRRC-CR-68-41; AFCRL-68-0509). CFSTI.

A theory of the electro-acoustic resonances of a nonuniform plasma that is based upon an expansion of the Vlasov equation is presented. The results of the expansion, when combined with Maxwell's equations, yield a single differential equation describing the rf acceleration as a function of distance into the plasma. The solution for the eigenmodes of a diffusion-controlled plasma is obtained, using a boundary condition that is based upon the reflection of electrons from the steady electric field in the plasma. The effects of collisionless (Landau) damping are considered by comparing the unperturbed electron trajectories with the velocities of the waves constituting the resonances in the phase plane. The eigenvalues for the resonances are compared with those obtained from moment theory. (auth) (USGRDR)

25395 WAVE PROPAGATION AND GROUP VELOCITY IN ABSORBING MEDIA. Neufeld, J. (Oak Ridge National Lab., Tenn.). Phys. Lett., 29A: 68-9(Apr. 7, 1969).

Brillouin's work dealing with the formulation of the group velocity and the velocity of energy transport has been extended to absorbing media. (auth)

25396 NONLINEAR OSCILLATIONS IN A WEAKLY IONIZED PLASMA. Willett, Joseph E.; Bogdanor, John L. (Univ. of Missouri, Columbia). J. Appl. Phys., 40: 1903-8(Mar. 15, 1969).

A perturbation theory is developed for a nonlinear longitudinal monochromatic wave in a weakly ionized plasma. The effect of collisions between electrons and neutrals is treated by means of a relaxation term in the Boltzmann–Vlasov equation. With the distribution function developed to all orders in the amplitude E_0 of the oscillating electric field (assumed exponentially damped sinusoidal in form), a constant damping decrement λ is indicated for two cases: Either (i) λ must be negligible or (ii) the collision frequency ν_R of the resonance electrons must be negligible in the calculation of the distribution function of the resonance electrons in terms of the electric field. With the nonlinear correction developed to lowest order, the Landau damping decrement is reduced from its linear value γ_{k_0} by the factor $1 - \frac{1}{8}(\Omega^4/\nu_k^4)$ for case (i), and by the factor $1 - \frac{1}{16}[\Omega^4/(|\gamma_{k_0}| + \bar{\nu})^4]$ for case (ii). Here $\bar{\nu}$ is the collision frequency appropriately averaged for direct collisional damping, $\Omega = (eE_0k_0/m)^{1/2}$ is the frequency of oscillation of the resonance electrons, k_0 is the wave number, and e and m are the electronic charge and mass, respectively. (auth)

25397 NONLINEAR INTERACTION OF A MICROWAVE FIELD WITH A PLASMA SLAB IN A WAVEGUIDE. Sforza, P. F. (Raytheon Co., Sudbury, Mass.). J. Appl. Phys., 40: 1908-17(Mar. 15, 1969).

The nonlinear interaction of the dominant TE(10) waveguide mode of a fundamental frequency with a plasma slab in an infinitely long rectangular waveguide is analyzed utilizing an approximate technique. Explicit expressions for the first three harmonic components of the electron density and current density in the plasma are given. General expressions for the nonlinearity generated second-harmonic electric fields are derived. Numerical results show that the second-harmonic power generated in the TM(11) waveguide mode is more than ten times that generated in the TE(11) waveguide mode. (auth)

25398 SUBHARMONIC GENERATION IN TONKS–DATTNER RESONANCES. Demokan, O.; Hsuan, H. C. S.; Lonngren, K. E. (Univ. of Iowa, Iowa City). Phys. Lett., 29A: 99-100(Apr. 7, 1969).

An experiment is described where subharmonics of an external signal are generated in a plasma column. Necessary conditions with respect to Tonks–Dattner resonances are also experimentally noted and qualitatively explained. (auth)

25399 SELF-ACTION OF WAVES IN RAREFIED PLASMA LOCATED IN A MAGNETIC FIELD. Gurevich, A. V.; Shvartsburg, A. B. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz., 56: 818-29(Mar. 1969). (In Russian).

An expression is derived for the four-photon interaction tensor in a plasma located in a magnetic field. The cubic current is found by means of the expression and general nonlinear equations are derived which determine self-action of waves in the absence of collisions. It is shown that self-action consists in a change in polarization and the appearance of amplitude modulation of the wave. These processes are of an oscillatory nature. The oscillation frequency is proportional to the wave energy. Solutions of the self-action equations are obtained for waves propagating perpendicular or parallel to the magnetic field. Resonances are investigated. The results of numerical calculations are presented. (auth)

25400 NONLINEAR DECAY INSTABILITY AND PARAMETRIC AMPLIFICATION OF CYCLOTRON-HARMONIC PLASMA WAVES. Porkolab, M.; Chang, R. P. H. (Princeton Univ., N. J.). Phys. Rev. Lett., 22: 826-9(Apr. 21, 1969).

Experimental observation of the resonant mode–mode coupling type of nonlinear decay instability and parametric amplification of cyclotron-harmonic waves is reported. The instability is due to the scattering of finite-amplitude waves. (auth)

25401 DESTABILIZATION OF NEGATIVE-ENERGY WAVES IN INHOMOGENEOUS MIRROR GEOMETRY. Berk, H. L.; Pearlstein, L. D.; Callen, J. D.; Horton, C. W.; Rosenbluth, M. N. (Univ. of California, Livermore). Phys. Rev. Lett., 22: 876-9 (Apr. 28, 1969).

It is well known that loss-cone-type distributions which occur in mirror machines give rise to stable negative-energy waves in infinite homogeneous geometry. It is shown here that the presence of spatial inhomogeneities along the magnetic field destabilizes these waves because of the presence of dissipation associated with the flow of electrostatic waves outward to the ends of the system. (auth)

25402 NONLINEAR LOW-FREQUENCY OSCILLATION SPECTRA IN AN ANISOTROPIC PLASMA. Makhan'kov, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz., 56: 950-3(Mar. 1969). (In Russian).

The effect of high-frequency Langmuir turbulences on the nonlinear low-frequency oscillation spectra of an anisotropic plasma is investigated. It is shown that under certain conditions in such a plasma aperiodic instabilities appear and an insignificant temperature anisotropy of the plasma may remain. (auth)

25403 LANDAU DAMPING OF ELECTROSTATIC ION WAVES IN A UNIFORM MAGNETIC FIELD. Hirose, A.; Alexeff, I.; Jones, W. D.; Krall, N. A.; Montgomery, D. (Oak Ridge National Lab., Tenn.). Phys. Lett., 29A: 31-2(Mar. 24, 1969).

Landau damping of electrostatic ion waves due to contaminant helium ions in a xenon plasma is studied as a function of frequency and propagation angle in a uniform magnetic field. For $\omega_{ci}^{Xe} \ll \omega \lesssim \omega_{ci}^{He}$, damping for perpendicular propagation is immeasurably small. The damping is recovered for $\omega > \omega_{ci}^{He}$. (auth)

25404 ACOUSTIC-WAVE GENERATION BY TEMPERATURE MODULATION OF A PLASMA. Fitaire, M.; Mantei, T. (Faculte des Sciences, Orsay, France). Phys. Lett., 29A: 84-5(Apr. 7, 1969).

Acoustic waves have been generated in the neutral-particle component of a weakly ionized gas by varying the plasma electron temperature with a low-power rf signal. (auth)

25405 PLASMA OSCILLATIONS IN SOLID AND LIQUID Sn AND Ga FOILS. Zeppenfeld, K. (Univ., Hamburg). Z. Phys., 223: 52-8(1969). (In German).

Energy-loss spectra of 50-keV electrons were measured in transmission of Sn and Ga foils. The spectra of the solid and the liquid states are very similar as expected from the free-electron model. The position, the half width, and the intensity of the volume plasmon peak are given as function of the scattering angle. (auth)

25406 WAVES ON AN ELECTRON BEAM IN VACUO AND IN A PLASMA. Self, Sidney A. (Stanford Univ., Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Electron Devices, ED-15: 889-95(Nov. 1968).

The problems of wave propagation on a cylindrical electron beam in a vacuum and in a plasma background are examined in an exact treatment, i.e., from Maxwell's equations, including relativistic effects. It is shown that certain ambiguous features of the more usual nonrelativistic quasi-static analysis are thereby resolved. For an electron beam in vacuo, the quasi-static analysis gave a solenoidal mode equation and also allowed a nonsolenoidal mode equation which does not couple to fields outside the beam. For an electron beam in an infinite plasma, the quasi-static analysis likewise gave a solenoidal mode, and also allowed a nonsolenoidal mode which does not couple to fields outside the beam. When the plasma is present, however, the exact treatment does not allow modes uncoupled to the external region and it is concluded that the nonsolenoidal mode of quasi-static theory is fictitious, and arises through making the quasi-static assumption ab initio. The same is true if the plasma is bounded. (BBB)

25407 MODULATION OF DISCHARGE PARAMETERS CAUSED BY ACOUSTIC WAVE. Aubrecht, L. Technical Univ., Prague). Czech. J. Phys., 19: 464-9(1969).

The propagation of acoustic waves in a partially ionized plasma in an external electric field is studied theoretically. It is assumed that an acoustic wave propagating through ionized gas causes only ion perturbations. The problem is studied in the hydrodynamic approach and the basic equation is solved by means of Laplace transformation. It was found that waves can propagate in plasma also at other frequencies and wave numbers except the wave with the frequency and wave number of the neutral sound wave. Relations are derived for the density of the perturbation current and the intensity of modulated light irradiated from the plasma, and the possible mechanism of the interaction of an acoustic wave with a discharge is taken into account. The necessity of further theoretical and experimental investigation is shown in conclusion. (auth)

25408 TRANSFORMATION AND ABSORPTION OF WAVES IN AN INHOMOGENEOUS BEAM–PLASMA SYSTEM. Kopecky, V.; Preinhaelter, J. (Inst. of Plasma Physics, Prague). Plasma Phys., 11: 333-43(Apr. 1969).

The propagation of high-frequency electrostatic waves excited by an electron beam in a hot inhomogeneous plasma in a magnetic field was studied. The gradient of the plasma density was assumed to be parallel to the magnetic field. It is found that in the region of the plasma resonance some waves are transformed into Langmuir waves with a significantly shorter wavelength. The latter may be strongly absorbed by the Landau damping. Thus, in a hot inhomogeneous plasma there exists a linear process leading to a plasma heating. (auth) (UK)

25409 ELECTRON CYCLOTRON DAMPING IN THE MICROWAVE RADIATION ALONG THE MAGNETIC FIELD. Nakamura, Sadao; Kubo, Hiroshi; Shimomura, Noboru; Mitani, Kenji (Kyoto Univ.). J. Phys. Soc. Jap., 26: 1069-70(Apr. 1969).

The circularly polarized microwave emission spectra along a magnetic field from a He plasma at 2×10^{-3} torr was found to contain a dip near the magnetic field $\omega_c/\omega = 1$ for the right-handed wave, but not for the left-handed wave. The position of the dips remains almost constant at $\omega_c/\omega \cong 1.0$ over the entire density range, while the normalized depths first increase and then decrease with $(\omega_p/\omega)^2$. The dips effect is analyzed under the assumption of electron cyclotron damping in a low-temperature Maxwellian plasma; the theoretical predictions agree with experiment. (D.L.C.)

25410 KINETIC EQUATION FOR RESONANT THREE-WAVE COUPLING. Davidson, Ronald C.; Kaufman, Allan N. (Univ. of California, Berkeley). J. Plasma Phys., 3: 97-105 (Feb. 1969).

The kinetic equation for resonant three-wave coupling is solved exactly in the one-dimensional case assuming that only a single triplet of modes is interacting. No assumptions are made as to the forms of the interaction kernel or of the oscillation frequencies as functions of wave-number. Both positive- and negative-energy waves are allowed to be present simultaneously. In explosively unstable situations the time t_∞, for divergent behaviour to occur is calculated in terms of the interaction kernel and initial conditions. In situations where the system is nonlinearly stable, the density of quasi particles is found to tend time asymptotically to a steady state which depends in detail on the initial preparation of the system. For the case of two or three dimensions, the asymptotic state is obtained when the system is stable, the k-space is finite, and only one triplet of modes interacts. If these modes all have the same sign of energy, the Rayleigh – Jeans distribution is valid; but if one of the modes has the opposite sign of energy, an additional conservation law leads to a modification of the Rayleigh – Jeans distribution. (auth) (UK)

25411 SOME REMARKS ON THE STATISTICAL THEORY OF OSCILLATIONS OF A RELATIVISTIC PLASMA IN A UNIFORM MAGNETIC FIELD. II. Draganu, Mircea. Mathematica, 9: 253-79(1967). (In Rumanian).

The general expressions derived in Part I of this study (see NSA 22: Abst. No. 7305) for the dielectric constants of a multicomponent relativistic plasma described in cylindrical coordinates in the presence of a constant magnetic field are here particularized for the case of a nonrelativistic plasma with anisotropic equilibrium distribution. The final formulas deduced in this manner generalize the analogous formulas given earlier by some other authors. Thereupon, the same relativistic plasma, but this time with Maxwellian equilibrium distribution only, is considered in spherical coordinates and the expressions for the plasma dielectric constants are again established in a direct manner. These expressions contain an integration relative to the modulus of the so-called relativistic generalized speed and another integration relative to the polar angle. This last integration is successfully performed. (auth)

25412 SURFACE WAVES GUIDED BY A PLANE UNGROUNDED MAGNETOPLASMA SLAB. Seshadri, S. R. (Univ. of Wisconsin, Madison). Int. J. Electron., 25: 481-94(Nov. 1968).

The characteristics of the plane surface waves supported by a plane ungrounded magnetoplasma slab are investigated for the case in which the magnetostatic field is oriented parallel to the two parallel interfaces but perpendicular to the direction of propagation. The dependence of the characteristics of the surface waves on the thickness of the plasma slab is discussed. For sufficiently small thickness of the plasma slab backward surface waves are found to exist. The group velocity as well as the amplitude characteristics of the surface waves are studied. (auth) (UK)

25413 WAVE TYPES AND THEIR PROPERTIES IN A UNIFORM WARM VISCOUS PLASMA WITH ELECTRON DRIFT. Moore, R. L. (McDonnell Douglas Corp., Long Beach, Calif.). Nuovo Cim., Suppl., 6: 1136-76(1968).

The exact dispersion equation for infinitesimal plane electroacoustic waves is derived, and found to differ from previous derivations because of the inclusion of kinematic viscosity and thermal conductivity. (J.F.P.)

25414 THE USE OF 9 X 9 MATRICES IN THE TREATMENT OF ELECTROMAGNETIC WAVE PROPAGATION IN ANISOTROPIC PLASMA. Heading, J. (University Coll. of Wales, Aberystwyth). Physica, 39: 141-55(July 1, 1968).

The theory of the propagation of electromagnetic waves in plane stratified anisotropic plasma has developed using matrix techniques and, recently, square matrices up to the order ten have been employed in most general problems. Here, 9×9 matrices are used, showing how the problem may be formulated in both differential and integral forms, and describing the methods by which such a representation can be manipulated. Comparison formulas for the reflection and transmission coefficients are derived from this approach. (auth)

25415 UNSTABLE WAVES IN A WEAKLY IONIZED HIGH-FREQUENCY MAGNETOPLASMA. Mumola, P. B.; Powers, E. J. (Univ. of Texas, Austin). Phys. Rev. Lett., 22: 991-3 (May 12, 1969).

Results of an experimental study of fluctuations of an unstable weakly ionized magnetoplasma with no axial drift is reported. Correlation measurements indicate that the observed waves propagate primarily in the azimuthal direction and that the parametric dependence of the phase velocity on pressure and magnetic field seem to be similar to that expected for a drift wave. The waves appear to be nonlocal in nature, the characteristic azimuthal and radial-mode numbers being unity. (auth)

25416 SMALL-AMPLITUDE WAVES IN HIGH-β PLASMAS. Formisano, V. (Massachusetts Inst. of Tech., Cambridge); Kennel, C. F. J. Plasma Phys., 3: 55-74(Feb. 1969).

A brief survey is presented of the phase velocities and polarizations of linear waves in an infinite, uniform, high-β plasma using the two-fluid approximation. Questions of wave–particle damping are deferred. Several features of high-β plasma waves differ from the familiar low-β case. (auth) (UK)

25417 LONGITUDINAL OSCILLATIONS OF A PLASMA HAVING A FERMI DISTRIBUTION OF ELECTRONS. Gibbons, M. (Univ. of Manchester, Eng.). J. Plasma Phys., 3: 47-54 (Feb. 1969).

The electrostatic oscillations of a plasma having a Fermi distribution of energies are discussed. The electrons, assumed to be tightly bound to the magnetic lines of force, are acted upon by a linear restoring force which causes them to oscillate with a fixed angular frequency ω_0. The dependence of the frequencies of oscillation of the plasma on electron density is calculated in the two limiting cases $\omega_{p0}/\omega_0 \ll 1$ and $\omega_{p0}/\omega_0 \gg 1$. (auth) (UK)

25418 LANDAU DAMPING OF LONG-WAVELENGTH ION-ACOUSTIC WAVES IN A COLLISION-FREE PLASMA WITH A GRAVITY FIELD. Parkinson, D.; Schindler, K. (European Space Research Inst., Rome). J. Plasma Phys., 3: 13-20 (Feb. 1969).

Ion acoustic waves propagating in a collision-free gravity-supported one-dimensional plasma are studied, including conditions where the wavelength is of the order of the scale height of the equilibrium plasma. It is found that the fluid dynamic steepening tendency of waves propagating in the direction of decreasing density is overcome by Landau damping up to wavelengths of the order of the scale height or even larger, depending on the ratio of the electron and the ion temperatures. (auth) (UK)

25419 RESISTIVELY MODIFIED NORMAL MODES OF AN INHOMOGENEOUS INCOMPRESSIBLE PLASMA. Boris, Jay Paul. Princeton, N. J., Princeton Univ., 1968. 250p.

Thesis.

The linear normal modes of an inhomogeneous, incompressible plasma are considered in a slab geometry, using the hydromagnetic equations with a small scalar resistivity. The magnetic field in the equilibrium is assumed parallel to the plane of the slab, and the unperturbed plasma density and each of the magnetic-field components are allowed to vary finitely and independently in the direction normal to the plane of the slab. An external gravitational field acting normal to the slab is also included. Boundary conditions appropriate to rigid, perfectly conducting walls are adopted to complete the specification of the linearized problem. By retaining an asymptotically small but nonzero resistivity in Ohm's law, the singularities of the infinite-conductivity equations are replaced by "resistive layers," thin regions in the slab where the eigenfunctions become large but remain finite and where the full set of equations with resistivity must be solved. (TSS) (Disser. Abstr.)

Shielding

25420 GAMMA-RAY BUILDUP FACTORS FOR SAND, AIR, AND WOOD (CELLULOSE). Clark, Francis H. (Oak Ridge National Lab., Tenn.). Nucl. Appl., 6: 588-91 (June 1969).

Gamma-ray buildup factors, both exposure (dose) and energy absorption, were calculated for sand (SiO_2), air ($N_{78}O_{22}$), and cellulose or wood ($C_6H_{10}O_5$). A moments method program coded for the CDC-1604 computer was the principal computing device used. (auth)

25421 PROTON SHIELD WEIGHT OPTIMIZATION. Rosen, Joseph S. (Computer Sciences Corp., Huntsville, Ala.). J. Nucl. Sci. Technol. (Tokyo), 6: 170-81 (Apr. 1969).

The calculus of variations is used to optimize the proton shield weight consistent with certain proton attenuation requirements, for voids which are bounded by general surfaces and shielded by some or all available materials suitable for proton shields. The thickness of the shielding materials and their order at each point are found in terms of a variable Lagrange multiplier, the relative stopping powers and densities of the eligible shielding materials and the geometry of the void surface at the point. Regions on the surface of the void are delineated wherein all the prescribed shielding materials can be used, while in other regions some of these materials must be dropped in a given order. (auth)

Solid-State Physics

Refer also to abstracts 24269, 24497, 25265, 25765, 25768, 25769, 26134, and 26143.

25422 (AED-C-12-17-1) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. SECTION 12: NUCLEAR SCIENCE LITERATURE OF EASTERN COUNTRIES. NUMBER 17-I. SOLID-STATE PHYSICS. Enssien, Benno (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). Sept. 1968. 576p. (In English and German). Dep.

2346 articles on various studies dealing with solids, dielectrics, and semiconductors are listed. Author indexes are included. (M.O.W.)

25423 (AED-C-12-17-2) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. SECTION 12: NUCLEAR SCIENCE LITERATURE OF EASTERN COUNTRIES. NUMBER 17-II. SOLID-STATE PHYSICS. Enssien, Benno (comp.) (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany)). Sept. 1968. 416p. (In English and German). Dep.

1683 papers on various aspects of solid state physics are listed. Author indexes are included. (M.O.W.)

25424 (CONF-650995-1) DOPING THIN CdTe LAYERS BY THE METHOD OF ION BOMBARDMENT + TABLE OF CONTENTS. Kachurin, G. A.; Gorodetskii, A. E.; Smirnov, L. S. Translated from Conference on Radiation Physics on Non-Metallic Crystals, Kiev, USSR. 7p. Dep. CFSTI.

Results of doping CdTe films with iodine ions at room temperature are presented. The resistance decrease is determined by the dose and energy; no correlation with current density of bombarding ions or film thickness was found. Equations are derived for the volume of disordered regions. The effects of annealing at 40 to 250°C were also studied. The activation energy for the resistance decrease was found to be 1.4 ± 0.3 eV, and at minimum resistance, the films had p-type conductivity and the mobility of the holes was 2 to 12 cm^2/V-sec. The resistivity increase on annealing above 200°C is due to iodine evaporation at the surface. The depth of the doped layer is 0.02 to 0.07 μ. (D.L.C.)

25425 (COO-1247-17) A STUDY OF VACANCIES IN TUNGSTEN QUENCHED IN SUPERFLUID HELIUM. Gripshover, Ronald Joseph (Michigan State Univ., East Lansing. Dept. of Physics). Apr. 10, 1969. Contract AT(11-1)-1247. 103p. Dep. CFSTI.

Thesis.

A system was constructed that permits the refractory bcc metals to be annealed and quenched in the ultrapure conditions which exist in and directly above superfluid helium. Studies were made on vacancies quenched into fine tungsten wires and the subsequent annealing away of this quenched-in resistance. To determine the effective vacancy formation energy, E_f^v, tungsten specimens are quenched from temperatures between 1500 and 3200°K. The quenched-in resistance varies somewhat from specimen to specimen, but the effective formation energy obtained for the fast quench data is nearly the same for all specimens and equal to 3.1 ± 0.2 eV. This data, together with Schultz's data, establishes both the magnitude of the quenched-in resistance and the effective formation energy for fast-quenched tungsten. By studying how the quenched-in resistance varies with quench speed, it is shown that the equilibrium vacancy concentration is probably not being retained even with the fast quench speeds. By extrapolating the data to infinite quench speed, the equilibrium vacancy resistance is estimated. The extrapolation leads to an estimate of $E_f^v = 3.5 \pm 0.2$ eV. The extrapolated data is also used to test Flynn's theory of vacancy annealing during the quench. The theory fits the infinite quench speed data, but there is slightly too much scatter to state definitively that Flynn's theory is applicable. This theory yields a value of 1.4 ± 0.2 eV for the vacancy motion energy. To study the annealing away of the quenched-in resistance, both isochronal and isothermal anneals were performed. There is a single major isochronal recovery stage in the range 800 to 1000°K in quenched tungsten, consistent with Stage-IV recovery in radiation damage and cold work studies. This single major recovery stage suggests there is a single defect present, presumably the vacancy. The isothermal recovery curve has an "S" shape suggesting complex annealing processes. Isothermal anneals with change-of-slope measurements yield an effective motion energy of 1.5 ± 0.3 eV. This estimate of the effective motion energy is in good agreement with the estimate obtained from the Flynn theory analysis. The "best values" for the effective formation and motion energies lead to a value of about 5 eV (3.5 + 1.5 eV) for Q. This is in reasonable agreement with the 5.2-eV estimate of Danneberg. The maximum Q which would still be consistent with the data is Q ~ 6 eV. However, the data do not appear to be consistent with either Q = 6.6 eV, or with $E_m^v = 3.3$ eV obtained from recent radiation damage studies. (auth)

25426 (EUR-3940-1, pp 159-76) RADIO-FREQUENCY SPECTROSCOPY OF MATTER. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center).

A brief discussion is given on each of the following topics: (1) nuclear magnetic resonance in liquid crystalline nematic systems, (2) EPR studies and electronic relaxation, (3) nuclear relaxation and self-diffusion, (4) dynamic polarization by the Overhauser effect, (5) dynamic polarization of atomic nuclei in solids, and (6) molecular motion and transport phenomena in solids. (M.O.W.)

25427 (EUR-3940-1, pp 177-97) SOLID STATE PHYSICS. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center).

A brief discussion is presented on each of the following: (1) low-temperature facility for neutron irradiation damage studies, (2) effects of ionizing radiation in ionic solids, (3) x-ray diffraction studies, (4) anelastic scattering of γ rays, (5) point defects in metals and alloys, (6) ionic conductivity of alkali metal halides, and (7) physical properties of nuclear materials. (M.O.W.)

25428 (IN-1218, pp 141-79) MATERIALS. (Idaho Nuclear Corp., Idaho Falls).

BERYLLIUM OXIDES—crystal lattice dynamics
BISMUTH—crystal structure at 26 kbar
CHROMIUM OXIDES—magnetic structure of, pressure dependence on Neel temperature of
CRYSTALS—lattice vibrations in, valence force model for calculating
—lattice vibrations in, computer program for calculating
CYCLOHEXANE—structure of liquid and solid, neutron molecular spectroscopy studies of
DIAMONDS—crystal vibrations in, valence force model for
ETHYLENE POLYMERS—neutron scattering cross sections at 4.2°K, thermal
—crystal structure at 26 kbar
—crystal structure of deuterated and normal, neutron diffraction study of
HEMATITES—magnetic structure at 41 kbar
LEAD—neutron scattering and collective motions in liquid, slow
MAGNESIUM STANNATE—crystal lattice dynamics
NEUTRONS, COLD—scattering on liquid lead, collective motions in
NEUTRONS, THERMAL—scattering on polyethylene at 4.2°K, cross sections for
SILICON—crystal vibrations in, valence force model for
SODIUM CHLORIDES—crystal lattice dynamics
THALLIUM—crystal lattice dynamics
ZIRCONIUM—crystal lattice dynamics (M.O.W.)

25429 THE MAGNETIC PROPERTIES OF THE COMPOUND Dy_3Al_2. Buschow, K. H. J. (Philips Research Labs., Eindhoven, Netherlands). Phys. Lett., 29A: 12-13(Mar. 24, 1969).

The magnetic properties of the tetragonal compound Dy_3Al_2 have been studied between 4.2 and 700°K in magnetic fields up to 30 kOe. Measurements parallel and perpendicular to the crystallographic c direction show that large crystalline anisotropies are present; they do not show a ferromagnetic-to-antiferromagnetic transition. Ferromagnetic ordering occurs near 105°K. (auth)

25430 FERROMAGNETIC RESONANCE IN NICKEL–VANADIUM ALLOYS. Heath, M.; Ronaldson, K. D. (Univ. of Nottingham, Eng.). Phys. Lett., 29A: 50-1(Apr. 7, 1969).

An investigation has been made of the ferromagnetic resonance absorption of a series of nickel alloys containing 2 to 8% vanadium by weight. A temperature-dependent g value has been found. The line width data support previous studies. (auth)

25431 NATURE OF DEFECTS IN ELECTRON-IRRADIATED COPPER. Haeussermann, F. (Max-Planck-Institut fuer Metallforschung, Stuttgart. Univ., Stuttgart); Ruehle, M.; Roth, G.; Scheidler, G. P. Phys. Status Solidi, 32: K103-6(Mar. 1, 1969).

Copper foils were irradiated at 140°K with 10^{20} 3-MeV electrons/cm^2, stored for 3 months at 20°C, and examined in an electron microscope. From diffraction-contrast and stereo measurements, it is concluded that the Frank dislocation loop model explains most of the results, and that both interstitial and vacancy clusters are observed, with their densities being about the same. (D.L.C.)

25432 DIFFUSION-CONTROLLED EXOELECTRON EMISSION (EEE) PHENOMENA IN BeO. Holzapfel, G. (Physikalisch-Technische Bundesanstalt, Brunswick). Phys. Status Solidi, 32: K63-5(Mar. 1, 1969).

A new exoelectron emission (EEE) phenomenon, a self-excitation controlled by electron diffusion, was discovered for powdered BeO. X irradiation produces this effect in the EEE glow curve, and storage greatly enhances it, while annealing at 370°C decreases it. The position of the self-excited glow peak (273°C) coincides with that of the tribo-glow curve, indicating that bulk traps are predominant in EEE-self-excitation. Self-excitation is believed to be due to the diffusion of unrecombined electrons from the inner bulk into the emission layer. (D.L.C.)

25433 STAGE-I RECOVERY OF RESISTIVITY IN ELECTRON-IRRADIATED SILVER AND GOLD. I. SILVER. Wiffen, F. W.; Snead, C. L. Jr.; Kauffman, J. W. (Northwestern Univ., Evanston, Ill.). Phys. Status Solidi, 32: 459-71(Mar. 1, 1969).

The stage I recovery of silver has been investigated by resistivity measurements and isochronal annealing of 99.999%-purity silver after irradiation with 2.0-MeV electrons at liquid-helium temperature. Detailed annealing schedules for several different initial defect concentrations and for a radiation-doped run confirmed the general similarity in the stage I recovery behavior of silver and copper and revealed the systematic differences between the two metals. Silver shows several first-order recovery substages and shows a small component of recovery due to free interstitial migration near 31°K. The total amount of recovery in stage I was found to be a sensitive function of defect concentration, for small defect concentrations, with the amount of recovery increasing for increasing initial damage over the range investigated. The observed results are explained in terms of a "competitive process, one interstitial model" with most of stage I recovery due to close-pair recombination. The fate of freely migrating interstitials is governed by the relative importance of impurity trapping, vacancy annihilation, and interstitial complex formation. The importance of each of these processes depends upon the initial defect concentration, impurity concentration, and the effectiveness of vacancies and interstitials for capturing interstitials. The higher probability of dimer formation in silver than in copper is a result of the larger radius of the interstitial strain field in silver and results in the smaller amount of stage I recovery, the smaller size of I_E, and is a major contributor to the observed lack of dose dependence in silver. (auth)

25434 DISLOCATION HELICES IN MOLYBDENUM. Becker, C.; Pegel, B. (Institut fuer Metallphysik und Reinstmetalle, Dresden). Phys. Status Solidi, 32: 443-6(Mar. 1, 1969).

Numerous large helical dislocations with lengths up to 4 mm and diameters between 10 and 130 μm have been observed in molybdenum by means of x-ray topography. From these observations, an equilibrium vacancy concentration of about 3×10^{-6} at 2000°C in molybdenum is derived. (auth)

25435 FIELD-ION-MICROSCOPE INVESTIGATION OF 10-MeV PROTON DAMAGE IN IRIDIUM. Petroff, P.; Washburn, J. (Univ. of California, Berkeley). Phys. Status Solidi, 32: 427-37(Mar. 1, 1969).

Annealed iridium specimens of 99.99% purity were irradiated at 5°K with 10-MeV protons in a field ion microscope attached to a cyclotron. Contrast effects due to point defects and their clusters were analyzed. By a field evaporation technique, the point defect distribution in the bulk was investigated. Interstitial migration to the surface was directly observed upon annealing in the temperature range 15 to 42°K. The decrease in the bulk concentration of interstitials during annealing in the temperature range 5 to 300°K indicated that stage I is caused by interstitial migration to close-by vacancies and traps and stage II was due to interstitial detrapping. Damage caused by irradiation at 5°K was compared to that introduced at 300°K. The damage which was large voids (400 to 500 vacancies) and dislocation loops suggested a different formation mechanism in the specimens irradiated at higher temperature. (auth)

25436 GENERATION OF THE EXCITON–IMPURITY COMPLEX BY FAST ELECTRONS. Glauberman, A. E.; Pundik, A. V.; Kozitskii, S. V.; Ruvinskii, M. A. (Odessa State Univ.). Phys. Status Solidi, 32: 61-6(Mar. 1, 1969).

The problem of excitation of the exciton–impurity complex (EIC) by fast electrons in a non-metallic crystal is considered using a many-electron approach. The operators which describe singlet and triplet state of EIC are introduced. The expressions for the probability of creation of the EIC are obtained and possible selection rules for corresponding transitions are analyzed. A comparison is made with the case of generation of free Wannier–Mott exciton. (auth)

25437 REFLECTIVITY AND BAND STRUCTURE OF EuO. Grant, P. M.; Suits, J. C. (IBM Research Lab., San Jose, Calif.). Appl. Phys. Lett., 14: 172-4(Mar. 1, 1969).

Near-normal incidence reflectivity of single-crystal EuO is reported for the energy range 1-9 eV. Results are interpreted in terms of recent band-structure calculations. (auth)

25438 LATTICE DYNAMICS OF AN ISOTOPIC DEFECT. Eisenriegler, E. (Kernforschungsanlage, Juelich, Ger.). Z. Phys., 222: 341-57(1969).

Using a spectrum $\sim\omega^2\sqrt{\omega_m^2-\omega^2}$ for the frequencies ω of the ideal crystal, simple analytic expressions are derived for the response function, phonon scattering cross section, and related quantities. The interpretation of resonances and localized vibrations as damped and undamped harmonic oscillators is discussed in detail. (auth)

25439 TYPE CONVERSION AND p–n JUNCTION FORMATION IN ION-IMPLANTED ZnTe. Hou, S. L.; Beck, K.; Marley, J. A. Jr. (Corning Glass Works, N. Y.). Appl. Phys. Lett., 14: 151-4(Mar. 1, 1969).

Type conversion and p–n junction formation, produced by the implantation of 400-keV F^+ ions into p-type ZnTe, have been confirmed by the termal probe test, photovoltaic effect, I–V characteristics, Hall effect, and EPR results. (auth)

25440 IONIC BOMBARDMENT OF NICKEL CRYSTALS WITH CHLORINE IONS. Vigner, Daniel; Auguin, Bernard; Riwan, Richard; Dagoury, Georges (CEN de Saclay, Gif-sur-Yvette, France). J. Microscop., 7: 609-20(Sept. 1968). (In French).

Nickel crystal surfaces with different orientations bombarded with 20-keV Cl ions were studied by electron diffraction and microscopy. The thin nickel chloride films grew epitaxially with the (0001) plane parallel to the undisturbed regions of the original surfaces and the facets created by the ion etching. A superlattice of the C(2 × 2) two-dimensional type was observed. By reaction with gaseous chlorine on the same surfaces, the nickel chloride formed crystallized above 100°C with a fiber axis [0001] normal to the surface. It was very hygroscopic and had to be handled with special care. (BBB)

25441 GENERALIZED SUSCEPTIBILITIES AND MAGNETIC PROPERTIES OF SOME BCC TRANSITION METALS. Evenson, W. E.; Fleming, G. S.; Liu, S. H. (Ames Lab., Iowa). Phys. Rev., 178: 930-2(Feb. 15, 1969).

With the energy bands for tungsten calculated by Mattheiss, the generalized susceptibilities $\chi(q)$ along ΓH for several bcc transition metals were calculated by appropriately adjusting the Fermi energies. The Fermi energies were chosen using Mattheiss's integrated density of states to have the proper number of electrons per atom to correspond to (a) the chromium series, (b) the vanadium series, and (c) europium. The procedures developed in the calculation of $\chi(q)$ for the heavy rare earths were used. The generalized susceptibility that corresponds to the chromium group has several small peaks and a prominent, narrow peak very near to H. The position of this prominent peak corresponds to the magnetic periodicity of chromium and to a Kohn anomaly observed in the Cr and Mo phonon spectra. The susceptibility for the vanadium group has a peak near the broad dip in the [00q]L branch of the phonon spectrum of niobium. The susceptibility for europium has a peak near the magnetic wave vector for europium. The Fermi surface for Eu derived from this set of bands is quite similar to that calculated by Andersen and Loucks, and the susceptibility shows the important nesting across the tetracube and the superegg pieces of the Fermi surface. (auth)

25442 TEMPERATURE COEFFICIENTS OF THE WORK FUNCTIONS OF THE (110) AND (100) SURFACES OF TUNGSTEN SINGLE CRYSTALS AND OF POLYCRYSTALLINE TUNGSTEN FOIL. Hopkins, B. J.; Lee, T. J.; Williams, C. B. (Univ. of Southampton, Eng.). J. Appl. Phys., 40: 1728-32(Mar. 15, 1969).

A modification of the Kelvin contact potential difference technique has been used to measure the temperature coefficient of the work function of three tungsten surfaces over the temperature range from 77 to 1300°K. Two of the surfaces were polished and etched single-crystal planes having the (110) and (100) orientations, while the third was a sample of polycrystalline foil. The results obtained were: foil: $(11 \pm 1) \times 10^{-5}$ eV/°K. (110): $(6.3 \pm 0.6) \times 10^{-5}$ eV/°K. (100): $(9.1 \pm 0.4) \times 10^{-5}$ eV/°K. They are in qualitative agreement with predictions based on the temperature dependence of the electron smoothing component of the surface double layer. (auth)

25443 EFFECTS OF NEUTRON IRRADIATION ON THE PHASE STABILITY OF SELECTED HIGH-PRESSURE POLYMORPHS. Kulcinski, G. L. (Battelle-Northwest, Richland, Wash.). J. Appl. Phys., 40: 1977-9(Mar. 15, 1969).

High-pressure polymorphs of Zr, InTe, P, PbO_2, and SiO_2, metastable under ambient conditions, were irradiated in a fast neutron flux of 2×10^{19} n/cm² and their structures determined afterwards. Omega Zr, orthorhombic PbO_2, and monoclinic SiO_2 showed no change in structure or lattice parameter. The cubic form of InTe showed a finite reversion to its stable tetragonal form; this could be due to heating effects. The orthorhomic (black) phase of P is completely converted into the amorphous (white) structure. (D.L.C.)

25444 EFFECT OF NEUTRON RADIATION ON DISLOCATION MOBILITY IN LiF CRYSTALS. Urusovskaya, A. A.; Perzhinova, M. (Inst. of Crystallography, Moscow, Inst. of Physics, Bratislava). Sov. Phys.-Solid State (Engl. Transl.), 10: 2487-8 (Apr. 1969).

Translated from Fiz. Tver. Tela, 10: 3146-8(Oct. 1968).

The effects of slow and fast neutron irradiation on microhardness, dislocation rosettes, and dislocation velocities in LiF single crystals were studied. Fast neutrons were found to be the greater hardening agent. Radiation defects, dose effects, and annealing effects are discussed. Gamma irradiation was also investigated and found to have an insignificant hardening effect. (D.L.C.)

25445 CALCIUM STANNATE: A SOURCE FOR MOESSBAUER MEASUREMENTS. Kalyamin, A. V.; Lur'e, B. G.; Popov, G. V.; Romanov, Yu. F. (Inst. of Semiconductors, Leningrad, Leningrad State Univ.). Sov. Phys.-Solid State (Engl. Transl.), 10: 2522-3(Apr. 1969).

Translated from Fiz. Tver. Tela, 10: 3180-2(Oct. 1968).

$CaSnO_3$ was synthesized and fabricated into sources for ^{119}Sn Moessbauer measurements. The results show that the source $Ca\,^{119m}SnO_3$ has a relatively narrow singlet line, with an $\epsilon(0)$ of ~20% for a linewidth of 1.0 mm/sec. The source linewidth is 0.40 ± 0.02 mm/sec and the probability of quantum absorption and emission without recoil is 0.58 ± 0.06. Thus, the $CaSnO_3$ Moessbauer source has an emission linewidth close to the natural linewidth and a large Moessbauer effect at room temperature. (D.L.C.)

25446 ON THE ENHANCEMENT OF γ-RAY COLORATION BY Mn^{2+} AND Mg^{2+} IN LITHIUM FLUORIDE. Laj, Carlo; Berge, Pierre (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). J. Phys. Chem. Solids, 30: 845-50(Apr. 1969).

Experimental studies of γ-ray coloration with variable irradiation rates of LiF doped with Mg^{2+} and Mn^{2+} gave new evidence that the vacancies created by charge compensation are converted into F centers after dissociation of an impurity–vacancy complex. The results are supported by EPR and ITC parallel measurements. (auth) (UK)

25447 EXPERIMENTAL SEPARATION OF THE TWO EXPONENTIAL COMPONENTS OF THE FIRST-STAGE F COLOURING IN KCl. Jaque, F.; Sanchez, C.; Agullo-Lopez, F. (Junta de Energia Nuclear, Madrid). Solid State Commun., 7: 553-7 (Apr. 1969).

The first stage of the room-temperature irradiation F-center coloring in KCl was shown to consist of two exponential components in addition to a linear component. The parameters of these components are similar to those found for NaCl. A simple coloring experiment was performed to inhibit the slow component and color the crystal through the fast process exclusively. (auth) (UK)

25448 INTERSTITIAL DIFFUSION OF EMANATION IN URANIUM MONOCARBIDE SINGLE CRYSTALS AT AND BELOW ROOM TEMPERATURE. Matzke, Hj. (CCR-EURATOM, Ispra, Italy). Solid State Commun., 7: 549-52(Apr. 1969).

Emanation recoil atoms were found to migrate in UC single crystals over distances of >100 Å within about 1 min and between −80 and +40°C. For this mobility an interstitial mechanism is suggested, with an activation enthalpy, ΔH, between 0.1 and 0.5 eV. (auth) (UK)

25449 STUDY BY MEANS OF ELECTRON PARAMAGNETIC RESONANCE AND OPTICAL ABSORPTION OF THE MOLECULAR ION Cl_2^- IN $KClO_4$ IRRADIATED BY X RAYS. Fayet, Jean-Claude; Thieblemont, Bernard; Pariset, Christian (CNRS, Orsay, France). Compt. Rend., Ser B, 268: 177-80(Jan. 13, 1969). (In French).

The irradiation of $KClO_4$ with x rays at ambient temperatures makes the paramagnetic radical (Cl–ClX), already studied in $KClO_4$, appear. Under the action of light this center is destroyed for the benefit of the Cl_2^- ion for which the EPR spectrum and the optical absorption spectrum are analyzed. (J.F.P.)

25450 RESISTANCE MINIMA IN NONDILUTE Ce–La AND Ce–Y ALLOYS. Elliott, R. O.; Hill, H. H.; Miner, W. N. (Los Alamos Scientific Lab., N. Mex.). Phys. Status Solidi, 32: 609-17(Apr. 1, 1969).

Minima that may be indicative of a spin-compensated magnetic state have been observed in the electrical resistivity data for certain nondilute, hexagonal Ce–La and Ce–Y alloys. Resistively determined Néel temperatures do not agree with those determined magnetically for Ce–La alloys containing $\gtrsim$21 at. % La. (auth)

25451 RESEARCH OF THE ANISOTROPIC POTENTIAL IN $Eu_2(WO_4)_3$ SINGLE CRYSTALS WITH 3 eV SAMARIUM RECOIL ATOMS BY MEANS OF NUCLEAR RESONANCE FLUORESCENCE. Abel, F.; Kalus, J. (Technische Hochschule, Munich). Phys. Status Solidi, 32: 619-30(Apr. 1, 1969).

The slowing-down behavior of 3-eV ^{152}Sm recoil nuclei which are created by the neutrino emission from ^{152m}Eu was studied in a single crystal of $Eu_2(WO_4)_3$ with the help of nuclear resonance fluorescence (NRF). The expected dependence of the NRF yield on the flight direction of the Sm nuclei in the anisotropic crystal potential was observed. The twofold rotational symmetry of the b_0-axis and the angle β of the monoclinic crystal reproduced themselves in the experimental results. The maximum variation of the NRF yield was $(3.9 \pm 0.1)\%$. The model which uses a

nonspherically symmetric parabolic potential $V(r,\vartheta,\varphi) = (M/2)r^2 C^2(\vartheta,\varphi)$ permitted the calculation of the theoretical NRF yield. The arbitrary parameter occurring in the model was determined by comparison with the experiment. (auth)

25452 CAPTURE OF GAS ATOMS DISSOLVED IN A SOLID BY A MOVING GAS BUBBLE. Mikhlin, E. Ya. (Inst. of Physics and Power Engineering, Obninsk, USSR). Phys. Status Solidi, 32: 645-50(Apr. 1, 1969).

The capture of dissolved gas atoms in a solid by a bubble moving in it is considered. The conditions are analyzed under which the bubble movement results in considerable changes of the gas quantity entering the bubble. (auth)

25453 BETA-EXCITATION OF CdS CRYSTALS. Schubert, G.; Schnuerer, E. (Physikalisch-Technisches Institut, Berlin). Phys. Status Solidi, 32: 679-85(Apr. 1, 1969).

Beta-excitation of CdS crystals with a majority blocking cathode and an ohmic anode gives rise to charge pulses in an integrating network. The analysis of the pulses allows one to evaluate effective mobilities and lifetimes of the carriers and the electron–hole pair production energy. The values obtained are reasonable and in agreement with those found by other authors, but the measured effective lifetimes are not identical with the high lifetimes of majority carriers typical for CdS in usual photoconductivity measurements. Care had to be taken to avoid space charge accumulation. (auth)

25454 ELECTRON AND NEUTRON DAMAGE IN MgF_2 CRYSTALS. Facey, O. E.; Lewis, D. L.; Sibley, W. A. (Oak Ridge National Lab., Tenn.). Phys. Status Solidi, 32: 831-7 (Apr. 1, 1969).

A comparison of electron- and neutron-radiation damage in MgF_2 single crystals was made by studying changes in the optical absorption. It is found that reactor irradiation introduces many more cluster centers than does electron irradiation. Annealing studies show that above 700°K, F centers are apparently mobile and aggregate to form M centers. Zero phonon and phonon-assisted lines are observed at 382.6, 384.5, 385.7, and 387.3 nm and have been shown to be associated with the broad assumption band at 370 nm that is due to M centers. (auth)

25455 FORMATION OF SECONDARY DEFECTS IN NICKEL. Laidler, J. J. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. Phys. Status Solidi, 32: K127-9(Apr. 1, 1969).

Bourret and Dantreppe (Phys. Status Solidi, 29: 283(1968)) observed small tetrahedral defects in Ni after neutron irradiation at 77°K and concluded that they were voids. It is pointed out that irradiation temperatures of ≥400°C and high neutron fluxes are required for producing observable voids in Ni, and that such voids should be octahedral in form. It is concluded that the tetrahedral defects are not voids, but probably small stacking fault tetrahedra. (D.L.C.)

25456 RARE-GAS DIFFUSION IN NEUTRON-IRRADIATED CsCl AND CsI. Felix, F. W.; Meier, K. (Hahn-Meitner-Institut, Berlin). Phys. Status Solidi, 32: K139-42(Apr. 1, 1969).

Pure CsCl, CsCl doped with RbCl or KCl, pure CsI, and CsI doped with KI were labeled with rare gas atoms by neutron irradiation, and the diffusion coefficients and their activation enthalpies were measured. In α–CsCl, the diffusion parameters are about equal for Ar, Kr, and Xe, while diffusion is enhanced to different degrees by the phase transformation to the beta form at 470°C. The results indicate a vacancy mechanism in α–CsCl and an interstitial mechanism in β–CsCl. CsI shows the same behavior as α–CsCl for Ar and Xe up to the melting point. (D.L.C.)

25457 F-CENTRE PRODUCTION IN MIXED ALKALI HALIDE CRYSTALS AS EVIDENCE FOR THE IMPORTANCE OF A REPLACEMENT COLLISION SEQUENCE IN F-CENTRE PRODUCTION. Still, P. B.; Pooley, D. (Atomic Energy Research Establishment, Harwell, Eng.). Phys. Status Solidi, 32: K147-50(Apr. 1, 1969).

F-center production was studied over the entire composition range in KCl_xBr_{1-x} and $K_yRb_{1-y}Cl$ irradiated with 400-keV electrons at 5°K. The relative efficiency of F-center production is much less than unity for the mixed crystals, whereas for KCl doped with 100 ppm Br^- or 50 ppm Tl^+ it is unity. The results indicate that the correlated replacement collision sequences necessary for F-center production, are much less efficient in mixed crystals than in pure crystals. (D.L.C.)

25458 SOLID-STATE AND NUCLEAR RESULTS FROM A MEASUREMENT OF THE PRESSURE DEPENDENCE OF THE ENERGY OF THE RESONANCE GAMMA RAY OF ^{197}Au. Roberts, Louis D.; Patterson, D. O.; Thomson, J. O.; Levey, R. P. (Oak Ridge National Lab., Tenn. Univ. of Tennessee, Knoxville). Phys. Rev., 179: 656-62(Mar. 15, 1969).

Metallic gold was subjected to a sequence of pressures in the range from 0 to 70.6 kbar at a temperature of 4.2°K, and the change of the energy of the ^{197}Au resonance γ ray with pressure was measured. The measurements were made by the Moessbauer method. The result for dE_γ/dP is in good agreement with an earlier prediction for this quantity based on a correlation of the Moessbauer isomer shift with residual electrical resistance for a series of dilute gold alloys. The Wigner–Seitz approximation was used to describe the gold 6s band, and this wave function has been calculated in a relativistic Hartree approximation. Within this treatment, it is found that the gold nucleus increases in size when excited, with $\Delta r/r \cong +1.5 \times 10^{-4}$. A brief comment is made on the bearing which these results have on the charge and screening of gold atoms in dilute gold alloys. (auth)

25459 PHOTOEMISSION INVESTIGATION OF THE ELECTRONIC STRUCTURE OF DYSPROSIUM. Lapeyre, Gerald J. (Montana State Univ., Bozeman). Phys. Rev., 179: 623-30 (Mar. 15, 1969).

Photoemission measurements in the spectral range from the threshold ϕ at 3.2 eV to 11.8 eV have been obtained from evaporated films of dysprosium. The energy distribution of the emitted electrons and the quantum yield were measured at room temperature and below the magnetic-ordering temperatures. The optical transitions are predominantly nondirect and temperature-independent. A high density of d-like states is observed near the Fermi energy (E_F), with a peak at $E - E_F = -0.3 \pm 0.1$ eV and a shoulder at $E - E_F = 1.1 \pm 0.1$ eV. The width of the s- and d-like filled states is 5.5 ± 0.2 eV. These observations are in very good agreement with recent band calculations. No structure is observed in the empty states for $E - E_F > 4$ eV. The emission of inelastically scattered electrons is observed in the energy distributions and their contribution to the measured distribution is estimated with a simple model. The scattering is attributed to contamination of the sample by residual gases in the vacuum. As a result of the scattering effects, only an estimate of the optical density of filled states is obtained for $E - E_F < -2.0$ eV. As a sample ages, an additional peak appears in the energy distributions at $E - h\nu + \phi = 2.7 \pm 0.1$ eV, and it is attributed to emissions from states produced by sample contamination. Structure in the energy distributions is also observed at $E - h\nu + \phi = 6.3 \pm 0.2$ eV. The possibility that the latter structure is due to f states is discussed. The data obtained at temperatures below the magnetic-ordering temperatures show no measurable effect. Thus, shifts due to magnetic ordering in the filled density of states are less than 0.3 eV. As expected, the general properties of the optical density of states for dysprosiun. are very similar to those obtained for gadolinium. (auth)

25460 EFFECT OF HYDROSTATIC PRESSURE ON THE RECOVERY OF ELECTRICAL PROPERTIES OF NEUTRON-IRRADIATED MOLYBDENUM. Kulcinski, G. L. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Phys. Rev., 179: 676-82(Mar. 15, 1969).

High-purity molybdenum has been irradiated at 40°C to a fluence of 6.2×10^{18} n/cm^2 (E > 1 MeV) and subsequently isochronally annealed at two pressures, ≤1 and 20,000 bar. At low pressure, the electrical resistance increase recovers in three stages, at 150, 425, and 575°C. The effect of pressure is to lower the 150°C recovery peak to 90°C; this shift implies a negative activation volume of migration of −0.9 molar volumes for the migrating defect. The 425°C peak is apparently also lowered by pressure, but because of its small magnitude and uncertainty in its position, more detailed data are required before any pressure coefficient can be determined. The final 575°C recovery peak is lowered to 375°C under pressure and displays a pressure coefficient of −10°C/kbar. (auth)

25461 GROUND-STATE SPLITTING OF TRIVALENT Gd AND Cm IN $ZrSiO_4$, $HfSiO_4$, AND $ThSiO_4$, DETERMINED BY ESR. Abraham, M. M.; Clark, G. W.; Finch, C. B.; Reynolds, R. W.; Zeldes, H. (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 50: 2057-62(Mar. 1, 1969).

The electron spin resonance spectrum of trivalent gadolinium impurity in the tetragonal host crystals of $ZrSiO_4$, $ThSiO_4$, and $HfSiO_4$ has been observed at X band, and the spin-Hamiltonian parameters were obtained at various temperatures. The dominant second-order parameter B_2^0 for Gd was observed to be negative in all three crystals. Hyperfine structure for the odd isotopes ^{155}Gd and ^{157}Gd was clearly resolved and measured. In $ThSiO_4$ crystals doped with trivalent curium, no ESR signals were detected, supporting the assumption of a large negative B_4^0 term for this ion in these hosts. (auth)

25462 ENERGY LEVELS OF Gd^{3+} IN FIVE HEXAGONAL CRYSTALS. Schwiesow, R. L.; Crosswhite, H. M. (Johns Hopkins Univ., Baltimore). J. Opt. Soc. Amer., 59: 592-602 (May 1969).

The optical absorption spectra of 1% Gd : $LaBr_3$, 5% Gd : $LaCl_3$, $GdCl_3$, 2% Gd : $Y(OH)_3$, and $Gd(OH)_3$ at 1.5°K in high resolution are given over the region 31,000 cm^{-1} to 41,000 cm^{-1}. Reduced matrix elements based on intermediate-coupling free-ion calculations are used to perform a crystal-field analysis for Gd^{3+} in a $\bar{6}$ (C_{3h}) symmetry electrostatic field. A least-squares fit to levels in each crystal has led to the assignment of M quantum numbers to most levels and of B_k^q parameters to each crystalline host. (auth)

25463 ENERGY LEVELS OF Gd^{3+} IN LaF_3. Schwiesow, R. L.; Crosswhite, H. M. (Johns Hopkins Univ., Baltimore). J. Opt. Soc. Amer., 59: 602-3(May 1969).

Absorption spectra of 0.2% Gd : LaF_3 have been measured for the transitions to $^6P_{7/2}$, $^6P_{5/2}$, and all ^6I groups. A crystal-field analysis based on presumed hexagonal site symmetry gives B_2^0 = 106 cm^{-1}, B_4^0 = 234 cm^{-1}, B_6^0 = 124 cm^{-1}, and B_6^6 = 850 cm^{-1}, in the Stevens normalization. (auth)

25464 M SPECTRA OF GADOLINIUM IN THE METAL AND THE OXIDE. Bonnelle, Christiane; Karnatak, Ramesh C. (Laboratoire de Chimie Physique, Paris). Compt. Rend., Ser. A, B, 268: 494-7(Feb. 10, 1969). (In French).

Emission bands and absorption spectra M_{IV} and M_V of gadolinium were observed for the metal and the oxide Gd_2O_3. The role of excitation conditions is discussed, more especially for the M_V emission of which the intensity distribution is found strongly perturbed by the presence of a line in resonance with the absorption line. The distributions of 4f occupied and unoccupied states in Gd and Gd_2O_3 are deduced and show the effect of chemical binding on the 4f occupied states. (tr-auth)

25465 F-CENTER FORMATION IN KCl CRYSTALS BY PULSED ELECTRON BEAM AT 80°K. Ueta, Masayasu; Kondo, Yasuhiro; Hirai, Masamitsu; Yoshinari, Takehisa (Tohoku Univ., Sendai). J. Phys. Soc. Jap., 26: 1000-6(Apr. 1969).

The transient formation and decay of F centers in KCl crystals have been studied using a pulsed electron beam from a linear accelerator. The electron pulse has a 30 nsec half width at 60 MeV and the maximum peak current is 1.2 A. In "as received" crystals F center formation is of the fast type which takes place in very short time less than the pulse width and generated F centers bleach partially within ~40 nsec probably due to the tunnelling annihilation with H centers. In "irradiated" crystals which are discolored and bleached with white light, the F center formation consists of the fast and slow types. The slow type formation has a time constant of 0.60 ± 0.02 μsec at 80°K which is the same as the decay time of the F center luminescence. The slow type formation is, therefore, considered to take place when an electron is captured by an anion vacancy through the first excited state of the F center. (auth)

25466 CALCULATION OF PARAMAGNETIC SUSCEPTIBILITIES FOR bcc TRANSITION METALS AND THEIR ALLOYS. Mori, Nubuo (Shibaura Inst. of Tech., Tokyo). J. Phys. Soc. Jap., 26: 926-32(Apr. 1969).

The approximate energy bands for Cr, Mo, and W metals are built up from the energy bands for the paramagnetic Cr metal by taking into account the spin–orbit interaction. The effect of the spin–orbit interaction to the paramagnetic susceptibilities for 3d, 4d, and 5d bcc transition metals and their alloys are investigated. The spin paramagnetic susceptibilities χ_s and the orbital paramagnetic susceptibilities χ_{orb} for 3d metals and their alloys are the largest, followed by those for 4d and 5d metals and their alloys in that order, and the mixed contribution due to the spin and orbital angular momentums, χ_{so}, is negligibly small. The calculated paramagnetic susceptibilities agree with the results of the experiments, by adopting the reasonable values of a molecular field coefficient. The method to analyze the paramagnetic susceptibilities for the alloys composed of 3d and 4d, 4d and 5d or 3d and 5d transition metals is suggested and the experimental results for V–Nb and Nb–Ta alloys are analyzed. (auth)

25467 NUCLEAR SPIN–LATTICE RELAXATION IN SCANDIUM AND LANTHANUM METALS. Masuda, Yoshika; Hashimoto, Masahiro (Nagoya Univ., Japan). J. Phys. Soc. Jap., 26: 1058(Apr. 1969).

Measurements of the nuclear spin-lattice relaxation time and nuclear quadrupole coupling constant were made at 10 MHz for hcp ^{45}Sc (99.98% pure) and at 5 MHz for dhcp ^{139}La. The contributions of s-contact, d-spin core polarization, and d-orbital interaction to the relaxation time and their atomic hyperfine fields were calculated. (D.L.C.)

25468 ANOMALIES IN THE ELECTRICAL RESISTIVITY OF ALLOYS OF VANADIUM WITH TRANSITION METALS. Taylor, M. A. (Atomic Energy Research Establishment, Harwell, Eng.). Physica, 39: 327-33(Aug. 26, 1968).

The temperature dependence of the electrical resistivity of solid solutions of manganese, iron, titanium, nickel and cobalt in vanadium has been measured from 20°K to 293°K. The anomaly in the temperature dependence of the resistivity of pure vanadium has also been found to occur in the majority of the alloys examined. (auth)

25469 SIMPLE MODEL FOR SEMICONDUCTOR–METAL TRANSITIONS: SmB_6 AND TRANSITION-METAL OXIDES. Falicov, L. M. (Univ. of California, Berkeley); Kimball, J. C. Phys. Rev. Lett., 22: 997-9(May 12, 1969).

A simple model is proposed for a semiconductor-metal transition, based on the existence of both localized (ionic) and band (Bloch) states. It differs from other theories in that one assumes the one-electron states to be essentially unchanged by the transition. The electron-hole interaction is responsible for the anomalous temperature dependence of the number of conduction electrons. For interactions larger than a critical value, a first-order semiconductor-metal phase transition takes place. (auth)

25470 CALCULATION OF THE TEMPERATURE DEPENDENCE OF THE KNIGHT SHIFT IN CADMIUM. Kasowski, R. V. (Univ. of Chicago); Falicov, L. M. Phys. Rev. Lett., 22: 1001-3(May 12, 1969).

The temperature dependence of both the isotropic and anisotropic parts of the Knight shift in cadmium is calculated and found to be in good agreement with experiment. Lattice vibrations effectively decrease the strength of the lattice potential and make it more isotropic. As the temperature increases the energy bands become thus more free-electron-like and the s character of the wave functions on portions of the Fermi surface increases. At the same time the cancellation due to different p contributions in the various sheets of Fermi surface is destroyed, and the anisotropy also increases. (auth)

25471 NUCLEAR HYPERFINE CONTRIBUTION TO THERMAL CONDUCTIVITY OF HOLMIUM. Rao, K. V. (Dalhousie Univ., Halifax, Can.). Phys. Rev. Lett., 22: 943-5(May 5, 1969).

Thermal conductivity of a holmium single crystal has been measured in the temperature range 0.6 to 4.2°K. Around 1°K there is a total enhancement of over 30% in the conductivity value and the Lorentz number increases sharply to beyond 3.8×10^{-8} W Ω/deg^2. When correlated with specific heat data, this extra contribution appears to be a nuclear hyperfine effect. A possible mechanism is proposed. (auth)

25472 THERMOELECTRIC POWER AND THE CONDUCTION MECHANISM IN NEARLY STOICHIOMETRIC URANIUM DIOXIDE SINGLE CRYSTALS. De Coninck, R. (SCK-CEN, Mol, Belg.); Devreese, J. Phys. Status Solidi, 32: 823-9(Apr. 1, 1969).

The thermoelectric power and electric conductivity were measured on nearly stoichiometric UO_2 single crystals in the temperature range of 170 to 1250°K. The activation energies deduced from the thermoelectric power and the electrical conductivity curves remain unchanged between 170 and 1000°K. However, their values are different from each other. The results are explained in terms of the small polaron theory, which is in agreement with previous analysis. (auth)

25473 ELECTRON SPIN RESONANCE OF γ-IRRADIATED TRIGLYCINE SULFATE. I. HINDERED MOTION OF $\dot{C}H_2$ IN A FREE RADICAL $\dot{C}H_2COO^-$. Kato, Terumasa; Abe, Ryuji (Nagoya Univ., Japan). J. Phys. Soc. Jap., 26: 948-52(Apr. 1969).

Three species of radicals were observed. One of these was already identified as $NH_3\dot{C}HOO^-$ by Ovenall et al. and by Blinc et al.. One of the other species, which appears as a triplet with an intensity ratio of 1 : 2 : 1, is identified as $\dot{C}H_2COO^-$. The principal values of A- and g-tensor of the radical are determined to be 25.1, 19.6 and 16.7 gauss and 1.9994, 1.9999 and 2.0009, respectively. From the temperature dependence of the spectra, it is concluded that the two protons in the $\dot{C}H_2COO^-$ exchange their sites with each other through a rotation of the $\dot{C}H_2$ group about the $C-C_N$ bond. (auth)

25474 ESR STUDY OF γ-IRRADIATED SODIUM THIOSULFATE SINGLE CRYSTALS. Aiki, Kunio (Kyushu Univ., Fukuoka). J. Phys. Soc. Jap., 26: 939-47(Apr. 1969).

For the trapped radicals A, B, C, D, and E, g- and ^{33}S hf-tensor parameters are determined. Radicals A, B, and C were identified as SSO_2^-, SSO^-, and SSO_3^-, respectively. For radical A, g-tensor parameters are different from that reported, and these support the model more adequately. Optical absorption of this radical is shown. Observation of the hf interaction with central ^{33}S of radi-

cal B confirms the reported model. For radical C, at least two sets of nonequivalent ^{33}S hf satellites are observed, then the identification of SSO_2^- for this radical becomes more reliable. A feature of thermal decomposition of this radical into others is shown. Radical D, with the same chemical formula as SSO^- but a conformation different from radical B in the crystal lattice, was found. (auth)

Theoretical Physics

25475 (FEI-139) TOWARD THE TASK OF THE NONRIGID ROTATOR. Gai, E. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1968. 14p. (In Russian). Dep.

The motion of the center of mass, the rotation of the whole system, including volume and surface oscillations are of great importance for determining the state of quantum-mechanical systems. Transition to quantum mechanics is achieved by substituting generalized pulses in the classical Hamiltonian of the motion of the solid. The rotation of a molecule may be studied by considering the solid as a system of material points at unknown distances from each other, using the approach employed in nuclear physics. This approach may be used only if it is known that the system has a rotational spectrum derived from its collective motion. This problem was examined on the basis of the study of the eigenvalues and eigenfunctions of the Hamiltonian. The results indicated that there are cases in which the rotational energy in the quantum-mechanical system, although calculation of the transition to quantum mechanics by the substitution of the Hamiltonian causes difficulties. (TTT)

25476 (ISSP-A-342) EIGENVALUES OF ORBITAL ANGULAR MOMENTUM. Suzuki, Masuo (Tokyo Univ. (Japan). Inst. for Solid State Physics). Dec. 1968. 8p. Dep.

Orbital angular momentum $L_z = xp_y - yp_x$ is transformed into the difference of the Hamiltonians for two independent one-dimensional harmonic oscillators by a unitary transformation $U = \exp(-iS)$, where $S = \pi/4\,(p_xp_y + xy)$ with $\hbar = 1$. Consequently, using only the elementary commutation relations $[x,p_x] = [y,p_y] = i$, it is shown that the eigenvalues of L_z are integer. (auth)

25477 (ITF-68-78) METHOD OF NON-EQUILIBRIUM STATISTICAL OPERATOR AND GENERALIZED KINETIC EQUATIONS. Pockrovski, L. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1968. 30p. (In Russian). (CONF-680949-5). Dep.

From 2nd Conference on Statistical and Physical Kinetics, Ukrainian, SSR.

Construction of the generalized kinetic equations by means of Zubarev's nonequilibrium statistical operator is being considered. The method, as well as that of Peletminski and Jatsenko is proved to lead to the same results as far as the systems with a weak interaction are concerned. The application of the methods for deriving Redfield-type kinetic equations for the weakly interacting systems is considered. The equation obtained contains the Bloch equation as a particular case. Essentially, the correlations of the detailed balance are obtained for the probabilities of the immediate transition without additional assumptions. (TSS) (auth)

25478 DISCRETE LEAST SQUARES METHOD FOR THE SOLUTION OF THE SCHROEDINGER EQUATION: APPLICATION TO THE NUCLEAR THREE-BODY PROBLEM. Bell, D. H.; Delves, L. M. (Univ. of Sussex, Brighton, Eng.). J. Comput. Phys., 3: 453-72(Apr. 1969).

A discrete least squares method for the solution of the Schroedinger equation is discussed, including in particular its convergence properties as the number of points in the mesh used and the number of terms in the trial function are each increased. The method provides a possible alternative to the usual Rayleigh–Ritz procedure especially when the matrix elements in this latter scheme have to be evaluated numerically; we therefore compare these two methods in the context of a simple nuclear three-body problem. It is concluded that the least squares method forms a useful adjunct to the Rayleigh–Ritz procedure, and provides in particular a useful estimate of its numerical accuracy. (auth)

25479 LOCALLY NORMAL STATES IN QUANTUM STATISTICAL MECHANICS. Hugenholtz, N. M.; Wieringa, J. D. (Rijks Univ., Groningen, Netherlands). Commun. Math. Phys., 11: 183-97(1969).

A sufficient condition is given in order that a von Neumann algebra with cyclic vector is quasi-standard. With the help of this result it is proved that a locally normal state with a cyclic and separating vector in the representation space gives rise to a quasi-standard von Neumann algebra. Furthermore it is proved that the representation space determined by a locally normal state in the Gel'fand–Naimark–Segel construction is separable. (auth)

25480 PARTICLE SOURCES AND THE SCHROEDINGER EQUATION IN THE ABSENCE OF A FIELD. Gillot, Genevieve (Institut de Calcul Numerique, Toulouse). Compt. Rend., Ser. A, B, 268: 449-52(Feb. 10, 1969). (In French).

The Schroedinger equation leads to the conservation equation of $\rho = \psi^*\psi$ which is basic to the understanding of quantum mechanics. It is no longer valid when there are sources (or sinks) of particles; one must then complete it by a second number, and it is shown that it is linked to the mass of the sources. These latter can be rejected at infinity where there is a null volume, and one sometimes forgets their existence. That explains why certain wave functions currently used, such as the plane wave, are not normalizable. (tr-auth)

25481 GROUND-STATE ENERGY OF A ONE-DIMENSIONAL MANY-BOSON SYSTEM. Bolsterli, M. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 178: 432(Feb. 5, 1969).

The ground-state energy for a model due to Lieb and Liniger (Phys. Rev., 130: 1605(1963)) is calculated in the pair approximation. (auth)

25482 ANALYTICALLY SOLVABLE PROBLEMS IN RADIATIVE TRANSFER. I. van Trigt, C. (Philips Research Labs., Eindhoven, Netherlands). Phys. Rev., 181: 97-114(May 5, 1969).

As is well known, the transfer of radiation in a medium is described by an integral equation, first given by Biberman and Holstein. They assumed that the emission coefficient is proportional to the absorption coefficient. After a discussion of the relation of this type of radiative transfer to Brownian motion, the integral equation is solved for a slab and for all line shapes of interest with and without hyperfine structure in the limit of high optical depth. (auth)

25483 KINETIC EQUATIONS AND LIGHT-MATTER INTERACTION. Henin, F. (Univ. Libre, Brussels). Physica, 39: 599-649(Sept. 30, 1968).

The evolution of strongly coupled systems is much clarified by the introduction of quasi particles in the Boltzmann representation. These quasi particles are described by a distribution function which is obtained by a new transformation from the asymptotic bare-particle distribution function. They are entities which from the points of view of both their dynamic (kinetic equation) and thermodynamic (entropy) properties, behave like weakly coupled objects. The application of these concepts to the problem of interaction between radiation and bound electrons is discussed here. The kinetic equation for quasi particles, i.e., electrons in perturbed levels, is derived up to order λ^4. Whereas the Pauli equation (Born approximation) only describes one-photon process, two-photon processes are now included. The meaning of the perturbed states, from the points of view of equilibrium properties and comparison with Rayleigh–Schroedinger perturbation expansion, is briefly discussed. The kinetic equation is then used to discuss the problem of spontaneous decay of an excited state, taking into account the contributions of one- and two-photon processes. First, a rather general model is used to exhibit the main differences between the bare and quasi-particle pictures. Then, development is restricted to a generalized Wigner–Weisskopf model, and mainly, the sequential decay is discussed. A brief comparison with the T-matrix formalism is sketched. (auth)

25484 THEORY OF NONLINEAR RESPONSE OF AN ISOLATED SPIN SYSTEM. Samokhin, A. A. (Lebedev Inst. of Physics, Moscow). Physica, 39: 541-59(Sept. 30, 1968).

A formal theory of nonlinear response, which is a generalization of Kubo's formalism, is developed on the particular example of an isolated paramagnetic spin system. After resummation of the whole perturbation expansion an exact formal equation for the mean magnetic moment is derived. The relation of the type $\chi^{is} = \chi^s$ is essentially used in the derivation. This equation contains correlation functions of all orders and it is capable to describe nonequilibrium behavior of the system which is driven arbitrary fast and far from initial equilibrium. Four special cases of nonlinear response are considered: the sudden and adiabatic approximations, the long-time generalization of the Kubo formula, and the kinetic regime of nonlinear response. In the latter case, the expression for nonlinear response in terms of the linear one is obtained that is valid, even though the external time-dependent field is not small. This expression can be verified experimentally. The concept of spin temperature and its generalization is also discussed in some detail. (auth)

25485 EXACT MASTER EQUATIONS. Fulinski, A.; Kramarczyk, W. J. (Jagellonian Univ., Krakow). Physica, 39: 575-92(Sept. 30, 1968).

An exact master equation (EME) of the Markovian form for the diagonal part of the density operator is derived from quantum-

dynamical laws. This equation contains the multiplication by some inverse tetradic operator instead of time integration, and is valid for systems with a time-dependent Hamiltonian also. The existence of such an equation implies that the presently known EME's, all formally non-Markovian, describe in fact a Markovian time evolution. Derivation of kinetic equations from the Markovian EME is simpler because no special "Markovianity assumption" is needed. The Pauli equation follows by making two approximations in the Markovian EME: (1) neglecting the terms of order higher than second in the nondiagonal part of the Hamiltonian, and (2) taking the long-time approximation (LTA). However, if no perturbational expansion terms are neglected, then LTA leaves in the Markovian EME only some destruction term, simply depending on time, which may be interpreted as describing equilibrium fluctuations. (auth)

25486 CHERENKOV RADIATION DUE TO A POINT CHARGE MOVING PERPENDICULARLY TO A CONDUCTING BARRIER. Khan, R. M. (City Coll., Calcutta). Physica, 39: 223-8 (Aug. 1, 1968).

Cherenkov radiation produced by a point charge moving at right angles to a conducting plane boundary in a semi-infinite dielectric medium has been considered. The intensity of radiation fluctuates with the radial distance from the path of the particle and the radiation in the vicinity of the boundary surface is equivalent to the usual transition radiation. (auth)

25487 TRANSITION RADIATION AND THE CHERENKOV EFFECT. Ott, Edward; Shmoys, J. (Cambridge Univ., Eng.). Quart. Appl. Math., 26: 187-96(July 1968).

When a charge crosses the boundary between 2 regions with different electrical properties a burst of electromagnetic energy, called transition radiation, is radiated. Earlier, v was assumed to be less than the speed of light in both media. The problem of what happens when v is greater than the speed of light in either one or both of the media is considered. In general there are 6 cases, 2 of which have been reported. In case 3 the charge goes from a medium in which it produces no Cherenkov radiation to a medium in which it does. The solution for this case demonstrates how the Cherenkov radiation establishes itself after the impact time at t = 0. In case 4 a charge producing Cherenkov radiation crosses into a region in which it produces no Cherenkov radiation. The angle of the Cherenkov wedge is determined. After impact one expects the wavefronts to act like infinite plane waves incident on the boundary. For an angle less than the critical angle, the incident Cherenkov wavefronts are expected to produce transmitted and reflected wavefronts. Above the critical angle, critical reflection should occur with no transmitted wave produced. In cases 5 and 6 the charge produces Cherenkov radiation in both media. The phenomena taking place in these situations should essentially be combinations of those occurring in cases 3 and 4. (BBB)

25488 SOME EXACT CALCULATIONS ON A CHAIN OF SPINS ½. II. Niemeijer, Th. (Rijksuniversiteit, Utrecht). Physica, 39: 313-26(Aug. 26, 1968).

The chain of spins ½ with anisotropic nearest neighbor interaction, known as the X−Y model, is studied with a small oscillating field superimposed on the constant field. Since the autocorrelation function of the magnetization was calculated in Part I, the susceptibility, as given by the Kubo formalism, can now easily be calculated. The implicit assumption of Kubo and Tomita that the after effects of the adiabatic switching on of the oscillating field vanish, can now be rigorously justified for this simple case by giving an exact procedure for solving the time-dependent Schroedinger equation in successive orders of the amplitude of the oscillating field. The imaginary part of the susceptibility is different from zero in a certain frequency range with the effect that energy will be absorbed by the chain if the frequency of the oscillating field lies within this range. If one assumes for the sake of simplicity that the chain is thermally completely isolated and that it always is in thermal equilibrium, the temperature will obviously increase in time since energy is being absorbed. An exact equation for the temperature as a function of time is derived in terms of the parameters characterizing the system in the limit of high temperatures and the temperature is seen to increase exponentially in time. (auth)

25489 COMMON APPROXIMATIONS IN MANY-BODY SYSTEMS. Revzen, M.; Trainor, L. E. H. (Univ. of Toronto). Can. J. Phys., 47: 847-52(Apr. 15, 1969).

A new way of presenting the random-phase and ladder approximations is introduced, which provides a convenient, probabilistic classification scheme and makes the fundamental nature of these approximations transparent. The physical interpretation of these approximations is reviewed in the light of this new method of presentation and the natural propagators to be associated with each approximation are discussed. (auth)

25490 FINITE TRANSFORM INVOLVING SPHEROIDAL WAVE FUNCTION AND ITS APPLICATIONS. Gupta, R. K. (Meerut Coll., India). Proc. Nat. Inst. Sci. India, Part A, 34: 289-300(Nov. 1968).

In a recent paper Gupta (1964) investigated a finite transform involving Mathieu functions analogous to finite Hankel transform and discussed its properties together with its application in solving the diffusion equation. Hitherto, however, a corresponding use of the spheroidal wave functions does not seem to have been made for the solution of boundary-value problems involving spheroidal wave functions. The aim of the present paper is to supply this deficiency. (auth)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 25781 and 25789.

Electromagnetic

Refer also to abstracts 25510, 25726, and 25779.

25491 (CERN-69-7, pp 257-61) PROPERTIES OF K_{13} DECAYS IN THE π-ν CENTER OF MASS SYSTEM. A NEW EXPERIMENTAL METHOD OF DETERMINING ξ AND ITS ENERGY DEPENDENCE. Marateck, S. L. (Pennsylvania Univ., Philadelphia); Rosen, S. P. (Purdue Univ., Lafayette, Ind.).

It is pointed out that in K_{13} decays the spectrum for the cosine of β, the angle between the lepton and neutrino in the $\pi-\nu$ center of mass system, is linear for the vector and scalar interactions and the scalar–vector interference term. If ξ is assumed constant then it can be determined from the intercept of the cos β spectrum in $K_{\mu 3}$ decays. And after weighting the linear cos β plot one can determine the dependence of ξ on t. (J.F.P.)

25492 (DESY-69/5) π^+ PRODUCTION WITH LINEARLY POLARIZED PHOTONS. Geweniger, C.; Heide, P.; Koetz, U.; Lewis, R. A.; Schmueser, P.; Skronn, H. J.; Wahl, H.; Wegener, K. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany). Hamburg Univ. (West Germany). II. Institut fuer Experimentalphysik). Feb. 1969. 10p. Dep.

Single π^+ production on protons by linearly polarized photons of 2.5 to 5 GeV was measured at squared four momentum transfers t between -0.01 and -0.6 $(GeV/c)^2$. The results show that the differential cross section $d\sigma_\perp/dt$ with the electric vector of the photon perpendicular to the reaction plane is much larger than $d\sigma\|/dt$ with the electric vector parallel to the reaction plane. The predictions of Regge models and of the vector meson dominance model are briefly discussed. (auth)

25493 (LNF-68/63) LOW'S PARTICLE: A REVIEW OF EXPERIMENTAL AND THEORETICAL DATA AND A PROPOSAL FOR AN $e^+e^- \rightarrow \gamma\gamma$ ADONE EXPERIMENT. Note No. 417. Costa, P.; Grillo, A. F. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Nov. 6, 1968. 9p. Dep.

Possible violations of quantum electrodynamics explained previously by introducing new particles are studied. The cross section of the interaction $e^+e^- \rightarrow \gamma + \gamma$ is calculated supposing the existence of a part'cle ($L^\pm$) having a mass greater than the electron mass and the same quantum numbers. (J.F.P.)

25494 (UCSB-34-P-135-8) HIGH ENERGY USER GROUP AT SANTA BARBARA. Progress Report, May 1968–March 1969. Caldwell, David O. (California Univ., Santa Barbara). Contract AT(11-1)-34. 10p. Dep. CFSTI.

The completed experiments include experiments to measure cross sections for the forward photoproduction of neutral pseudoscalar and vector mesons by observing the accompanying recoil protons, and $\pi^+-\pi^-$ lifetime determinations. The experiments in progress are the measurement of the total photoabsorption cross section for producing hadrons and the measurement of the total photoabsorption cross section as a function of A for hadron final states. (J.F.P.)

25495 π^+ PRODUCTION WITH LINEARLY POLARIZED PHOTONS. Geweniger, C.; Heide, P.; Koetz, U.; Lewis, R. A.; Schmueser, P.; Skronn, H. J.; Wahl, H.; Wegener, K. (Deutsches Elektronen-Synchrotron, Hamburg. Univ., Hamburg). Phys. Lett., 29B: 41-4(Mar. 31, 1969).

Single π^+ production on protons by linearly polarized photons of 2.5 to 5 GeV was measured at squared four momentum transfers t between -0.01 and -0.6 $(GeV/c)^2$. The results show that the differential cross section $d\sigma_\perp/dt$ with the electric vector of the photon perpendicular to the reaction plane is much larger than $d\sigma_\|/dt$ with the electric vector parallel to the reaction plane. The predictions of Regge models and of the vector meson dominance model are briefly discussed. (auth)

25496 PRODUCTION OF K_2^0 MESONS AND NEUTRONS BY 10- AND 16-GeV ELECTRONS ON BERYLLIUM. Brody, A. D.; Johnson, W. D.; Leith, D. W. G. S.; (and others) (Stanford Univ., Calif.). Phys. Rev. Lett., 22: 966-9(May 5, 1969).

The K_2^0 yields were measured for electron energies of 10 and 16 GeV and at production angles of 2° and 4°, using a 40-in. hydrogen bubble chamber as a K_2^0 detector. The observed yields are compared with the predictions of a model involving the intermediate photoproduction of $\varphi(1020)$ mesons. In addition, the relative neutron-to-K_2^0 ratio was measured as a function of the secondary beam momentum. (auth)

25497 PHOTOPRODUCTION OF THE ETA MESON ON DEUTERIUM. Bacci, C. (Istituto Nazionale di Fisica Nucleare, Rome); Baldini-Celio, R.; Mencuccini, C.; Reale, A.; Spinetti, M.; Zallo, A. Phys. Lett., 28B: 687-9(Mar. 17, 1969).

The differential cross section at several c.m. angles for inelastic eta meson photoproduction on deuterium was measured at an incident photon energy of about 850 MeV. The results indicate that the photoproduction cross section on the neutron is quite similar to that on the proton. Both these c.m. angular distributions are consistent with isotropy. Remarks are made on the relative contribution of the isoscalar and isovector parts of the eta photoproduction amplitude. (auth)

25498 IMPROVED UPPER LIMIT TO THE ELECTRIC DIPOLE MOMENT OF THE NEUTRON. Baird, J. K. (Oak Ridge National Lab., Tenn.); Miller, P. D.; Dress, W. B.; Ramsey, Norman F. Phys. Rev., 179: 1285-91(Mar. 25, 1969).

A neutron-beam magnetic-resonance experiment was used to measure the electric dipole moment μ_e of the neutron. Although the results for μ_e differ from zero by 1.4 times the statistical error, the measurement is best interpreted as setting an upper limit on μ_e of $|\mu_e/e| < 5 \times 10^{-23}$ cm, where e is the charge on the proton. (auth)

Weak

Refer also to abstract 25494.

25499 (AD-677064) MUON POLARIZATION IN NEUTRAL-KAON (3) DECAY. Longo, Michael J.; Young, Kenneth K.; Helland, Jerome A. (Michigan Univ., Ann Arbor. Dept. of Physics). Sept. 1968. Contract Nonr-1224(23). 69p. (TR-33-03106-33-T). CFSTI.

An experiment to measure the polarization of muons from neutral-$K_{\mu 3}$ decay was carried out at the Bevatron with counter techniques. All three components of the polarization were measured. The time-reversal violating component transverse to the decay plane was found to be $= -.005 \pm 0.019$, which is consistent with T-invariance. The result for the form factor ratio zeta = f–/f+ was Re zeta $= -1.81 + 0.50$ or -0.26, Im zeta $= -0.02 \pm 0.08$, Arg (zeta)-$\pi = 0.6 \pm 2.6°$, if zeta is assumed to be independent of q^2. If zeta is not too strongly dependent on q^2 this result still holds true for zeta at $q^2 \approx 2.65$ $(m_\pi)^2$, the average q^2, selected by our apparatus. (auth) (USGRDR)

25500 (AD-679190) EXPERIMENTAL STUDY OF SOME RADIATIVE DECAY MODES OF THE K (L) AND K (S) MESONS. Technical Report, April 1967–October 1968. Pilcher, James E. (Princeton Univ., N. J. Elementary Particles Lab.). Oct. 31, 1968. 142p. (TR-49). CFSTI.

Thesis.

A study of radiative decays of the neutral K mesons yielded the following limits with 90% confidence: R ($K_s \rightarrow 2\gamma$)/R ($K_s \rightarrow$ all) < 1.2%, R ($K_L \rightarrow \pi^+ + \pi^- + \gamma$)/R ($K_L \rightarrow$ all) < 0.0056, and R ($K_L \rightarrow \pi^0 + 2\gamma$)/R ($K_L \rightarrow$ all) < 0.00023. The branching ratio R ($K_L \rightarrow 2\gamma$)/R ($K_L \rightarrow$ all) is found to be $(5.0 \pm 0.6)\ 10^{-4}$, based on 115 events observed with negligible background. (auth) (USGRDR)

25501 (CERN-69-7) TOPICAL CONFERENCE ON WEAK INTERACTIONS, CERN, GENEVA, 14–17 JANUARY 1969. (European Organization for Nuclear Research, Geneva (Switzerland)). Mar. 27, 1969. 538p. (CONF-690107). Dep.

The conference included 34 papers two of which were abstracted previously in NSA. For abstracts of these papers see abstract numbers: 23: 16926 and 23: 16985. Separate abstracts were prepared for 32 papers. (J.F.P.)

For abstracts of individual papers see: 25491, 25502–25513, 25535, 25571–25579, 25594, 25661, 25665–25668, 25683, 25684, and 25704.

25502 (CERN-69-7, pp 1-42) ACCELERATOR NEUTRINO EXPERIMENTS. Perkins, D. H. (Oxford Univ. (England). Nuclear Physics Lab.).

The properties of purely leptonic weak currents, as measured with neutrino beams are considered. Also some semileptonic interactions involving weak hadron currents are discussed. (J.F.P.)

25503 (CERN-69-7, pp 43-59) SINGLE PION PRODUCTION BY HIGH-ENERGY NEUTRINOS. Franzinetti, C. (Turin Univ. (Italy). Istituto di Fisica. Istituto [Nazionale] di Fisica Nucleare, Turin (Italy)).

Some results which were obtained at CERN from the exposure of the heavy liquid bubble chamber to the neutrino beam are presented. A comparison with theoretical prediction is carried out, and an estimate of the axial form factor is given. (J.F.P.)

25504 (CERN-69-7, pp 61-71) DEPENDENCE OF ν-NUCLEUS CROSS SECTIONS ON THE MASS NUMBER. Borer, K.; Hahn, B.; Hofer, H.; Krienen, F.; Seiler, P. G. ([Bern Univ. (Switzerland). Physikalisches Institut. European Organization for Nuclear Research, Geneva (Switzerland). Fribourg Univ. (Switzerland)]).

Data are presented which were obtained from a spark chamber and propane bubble chamber study of neutrino reactions with lead, carbon, iron, and aluminum. (J.F.P.)

25505 (CERN-69-7, pp 73) DISCUSSION REMARK ON MULTIMESON PRODUCTION. Roe, B. P. (Michigan Univ., Ann Arbor).

From data obtained from neutrino interactions in a propane bubble chamber it is found that there is no evidence for the production of vector mesons; however, the $\Delta(1236)$ dominates almost every channel. (J.F.P.)

25506 (CERN-69-7, pp 75-89) DIFFRACTION MODEL OF HIGH ENERGY NEUTRINO INTERACTIONS. Piketty, C. A.; Stodolsky, L. (Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies).

A discussion is given of the diffractive model of high-energy neutrino interactions. This discussion covers the qualitative aspects, the vector current for electroproduction, the axial current, and the asymptotic behavior. (J.F.P.)

25507 (CERN-69-7, pp 91-100) REDUCED EXPERIMENTAL UPPER LIMIT ON THE ELECTRON-NEUTRINO REST MASS. Bergkvist, Karl-Erik (Stockholm Univ. (Sweden). Research Inst. for Physics).

An experiment on the electron neutrino mass is reported. The electrostatic magnetic spectrometer with an energy resolution width $\Delta E = m_\nu c^2$ is used to measure whether or not there are beta particles immediately below the extrapolated upper energy limit $E_{\beta\ max}$ on the beta spectrum of tritium. The instrumentation used for this experiment is described. (J.F.P.)

25508 (CERN-69-7, pp 101-9) COSMIC RAYS AND WEAK INTERACTIONS: A CRITICAL REVIEW OF THE EXPERIMENTAL STATUS. Reines, F. (California Univ., Irvine).

A review is given of cosmic neutrino and muon interaction experiments. These experiments show the interaction of high-energy atmospheric neutrinos; an excess of muons reaching the earth's surface at large zenith angles; muon decay, in a few hundred GeV region, produced by neutrals in the cosmic rays at the earth's surface; and negative results on neutrino energies below 1 MeV. (J.F.P.)

25509 (CERN-69-7, pp 111-30) NEUTRINOS IN ASTROPHYSICS. Ruderman, M. A. (New York Univ., N. Y. Dept. of Physics).

A discussion on weakly interacting neutrinos emitted by hot stellar cores is given. This discussion covers neutrino astronomy, and the present status of attempts to use astronomical observations to gain information about the form and magnitude of the canonocal weak electron-neutrino self-coupling. (J.F.P.)

25510 (CERN-69-7, pp 131-82) HYPERON DECAYS. Filthuth, H. (Heidelberg Univ. (West Germany). Institut fuer Hochenergiephysik).

The leptonic and hadronic decays of the Λ, Σ, Ξ, and Ω^- are reviewed. The results of various experiments describing these decays are given. (J.F.P.)

25511 (CERN-69-7, pp 183-96) THEORY OF NONLEPTONIC HYPERON DECAYS: A SURVEY. Lee, Benjamin W. (Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies. Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France)).

Current algebra treatment of nonleptonic hyperon decays is reviewed. The evaluation of the magnitude of the weak amplitude is mainly discussed. (J.F.P.)

25512 (CERN-69-7, pp 205-23) NONLEPTONIC K DECAY. Aubert, B. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire).

A review of nonleptonic K decay is presented. The radiative decay 2π, and 3π decays are considered. It is concluded that the $\Delta I = \frac{1}{2}$ sum rule appears to be violated in the decay $K^0 \to 2\pi$ and that the violation there is of the same order of magnitude as in K^+ decay. (J.F.P.)

25513 (CERN-69-7, pp 329-38) INTERFERENCE BETWEEN K_2 AND K_1 AMPLITUDES IN THE $\pi^+\pi^-$ DECAY MODE. Bott-Bodenhausen, M: de Bouard, X.; Cassel, D. G.; (and others) (European Organization for Nuclear Research, Geneva (Switzerland)).

Final results from an experiment in which the decay rate of $K^0 \to \pi^+ + \pi^-$ behind a regenerator are reported. The observed rates are listed and their time dependence is shown. (J.F.P.)

25514 SYSTEMATIC INVESTIGATION OF MESONIC HYPERNUCLEI WITH FOUR AND MORE DECAY PRONGS. Barletta, W. A.; Harmsen, D.-M. (Univ. of Chicago). Nucl. Phys., B10: 99-106(1969).

The results of a systematic investigation of mesonic decays of hypernuclei into four and more charged particles, based on a sample of 74 events, are presented. The question of a particle-stable ${}^6_\Lambda$Li hypernucleus is further discussed. (auth)

25515 QUASIELASTIC NEUTRINO SCATTERING. Kustom, R. L. (Argonne National Lab., Ill.); Lundquist, D. E.; Novey, T. B.; Yokosawa, A.; Chilton, Frank. Phys. Rev. Lett., 22: 1014-17(May 12, 1969).

Quasielastic scattering of neutrinos, $\nu + n \to p^+ + \mu^-$, was measured in a 30-ton spark-chamber detector. Analysis of the cross section versus momentum transfer yields a value of $M_{A1} = 0.7 \pm 0.15$ for a single-pole-type axial-vector form factor or $M_{A2} = 1.05 \pm 0.2$ for a double-pole form factor. No decrease in cross section at low momentum transfer expected due to nuclear effects was observed. (auth)

25516 π^+ DECAY OF ${}_\Lambda$He^4. Phillips, R. E.; Schneps, J. (Tufts Univ., Medford, Mass.). Phys. Rev., 179: 1292-3(Mar. 25, 1969).

Among a sample of 1222 mesonically decaying hypernuclei of range greater than 20 μ, three cases of π^+ decay of ${}_\Lambda$He^4 were observed. The total number of π^- decays of ${}_\Lambda$He^4 to be 184 ± 52 was estimated. This yields a π^+-to-π^- branching ratio of $(1.6 \pm 1.3)\%$. This value is lower than that recently reported by Mayeur et al., $(9 \pm 3)\%$. The average value of the energy of the three π^+ mesons from the ${}_\Lambda$He^4 events was 13.3 MeV. (auth)

Strong (Baryon-Induced)

Refer also to abstracts 25647, 25803, and 25806.

25517 INVESTIGATION OF N$\pi\pi$ COMBINATIONS IN REACTION $np \to p\pi^+\pi^+\pi^-\pi^- n(m\pi^0)$ AT THE NEUTRON ENERGY 2 TO 10 GeV. Moroz, V. I.; Nikitin, A. V.; Troyan, Yu. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 9: 374-7(Feb. 1969). (In Russian).

730 events of the type $np \to p\pi^+\pi^+\pi^-\pi^- n(m\pi^0)$ produced in the propane bubble chamber exposed to the neutrons with energies from 2 up to 10 GeV, are selected. It is shown that the effective-mass distributions for the $p\pi^+\pi^+$, $p\pi^+\pi^-$ and $p\pi^-\pi^-$ combinations are satisfactorily explained by the N^{++}_{1236} and N^{*-}_{1236} isobar production. (auth)

25518 P-P SCATTERING AT THE INTERFERENCE MINIMUM AND APPLICATIONS OF THE ABSOLUTE VELOCITY GAUGE TECHNIQUE. Seagrave, John D. (Los Alamos Scientific Lab., N. Mex.). pp 305-21 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 1. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.1).

A review is given of a unique experiment on p + p scattering at the interference minimum, and applications of the absolute velocity gauge technique are illustrated. The experimental design, energy determination, results, and energy scale measurements are discussed. (J.F.P.)

25519 EXISTENCE AND PROPERTIES OF THE C-MESON AS OBSERVED IN $\bar{p}p$ ANNIHILATIONS AT REST. Astier, A. (College de France, Paris); Cohen-Ganouna, J.; Della-Negra, M.; (and others). Nucl. Phys., B10: 65-88(1969).

It is shown that the four-body $\bar{p}p$ annihilations at rest: $\bar{p}p \to K\bar{K}\pi\pi$ cannot be interpreted without the introduction of a $K\pi\pi$ resonance, the C-meson. The properties of the C-meson found are the following $M = 1242^{+\frac{1}{10}}_{-\frac{1}{10}}$ MeV, $\Gamma = 127^{+\frac{1}{5}}_{-\frac{1}{5}}$ MeV, $I\,J^P = \frac{1}{2}\,1^+$. (auth)

25520 EXPERIMENTAL STUDY OF ANTIPROTON-PROTON ANNIHILATION INTO A PAIR OF CHANGED PI-MESONS OR K-MESONS FOR INCIDENT ANTIPROTON MOMENTA IN THE RANGE FROM 0.72 GeV/c TO 2.62 GeV/c. Fong, Douglas Gun. Pasadena, Calif., California Inst. of Tech., 1968. 190p.

Thesis.

The cross sections for the two antiproton-proton annihilation-in-flight modes, $\bar{p} + p \rightarrow \pi^+ + \pi^-$ and $\bar{p} + p \rightarrow k^+ + k^-$ were measured for fifteen laboratory antiproton beam momenta ranging from 0.72 to 2.62 GeV/c. No magnets were used to determine the charges in the final state. As a result, the angular distributions were obtained in the form $[d\sigma/d\Omega\ (\Theta_{CM}) + d\sigma/d\Omega\ (\pi - \Theta_{CM})]$ for $45 \lesssim \Theta \lesssim 135°$. A hodoscope-counter system was used to discriminate against events with final states having more than two particles and antiproton-proton elastic scattering events. One spark chamber was used to record the track of each of the two charged final particles. A total of about 40,000 pictures were taken. The events were analyzed by measuring the laboratory angle of the track in each chamber. The value of the square of the mass of the final particles was calculated for each event assuming the reaction $\bar{p} + p \rightarrow$ a pair of particles with equal masses. About 20,000 events were found to be either annihilation into π^+-pair or k^+-pair events. The two different charged meson pair modes were also distinctly separated. The average differential cross section of $\bar{p} + p \rightarrow \pi^+ + \pi^-$ varied from ~25 μb/sr at antiproton beam momentum 0.72 GeV/c (total energy in center-of-mass system, $\sqrt{s}$ = 2.0 GeV) to ~2 μb/sr at beam momentum 2.62 GeV/c ($\sqrt{s}$ = 2.64 GeV). The most striking feature in the angular distribution was a peak at $\Theta_{CM} = 90°$ ($\cos \Theta_{CM} = 0$) which increased with $\sqrt{s}$ and reached a maximum at $\sqrt{s} \sim 2.1$ GeV (beam momentum ~1.1 GeV/c). Then it diminished and seemed to disappear completely at $\sqrt{s} \sim 2.5$ GeV (beam momentum ~2.13 GeV/c). A valley in the angular distribution occurred at $\cos \Theta_{CM} \approx 0.4$. The differential cross section then increased as $\cos \Theta_{CM}$ approached 1. The average differential cross section for $\bar{p} + p \rightarrow k^+ + k^-$ was about one third of that of the $\pi^\pm$-pair mode throughout the energy range of this experiment. At the lower energies, the angular distribution, unlike that of the $\pi^\pm$-pair mode, was quite isotropic. However, a peak at $\Theta_{CM} = 90°$ seemed to develop at $\sqrt{s} \sim 2.37$ GeV (antiproton beam momentum ~1.82 GeV/c). No observable change was seen at that energy in the $\pi^\pm$-pair cross section. The possible connection of these features with the observed meson resonance at 2.2 GeV and 2.38 GeV, and its implications, were discussed. (Disser. Abstr.)

25521 PHASE-SHIFT ANALYSIS OF HIGH-PRECISION (p,p) DIFFERENTIAL CROSS-SECTION DATA AT 6.141, 8.097, AND 9.918 MeV. MacGregor, Malcolm H.; Arndt, Richard A.; Wright, Robert M. (Univ. of California, Livermore). Phys. Rev., 179: 1624-6(Mar. 25, 1969).

Recent high-precision (p,p) differential cross-section data at 6.141, 8.097, and 9.918 MeV from Berkeley have been phase-shift analyzed. The data at 9.918 MeV are not consistent with the data at 6.141 and 8.097 MeV, and they are also inconsistent with other (p,p) data at nearby energies. (auth)

25522 PROTON–PROTON TRIPLE SCATTERING AT 1.9 GeV. Carithers, W. C. Jr. (Yale Univ., New Haven); Adair, R. K.; Hawkins, C. J. B.; Kasha, H.; Larsen, R. C.; Leipuner, L. B.; Smith, L. W.; Wangler, T. P. Phys. Rev., 179: 1304-14 (Mar. 25, 1969).

The Wolfenstein triple-scattering parameters R, D, and A' were measured at 1.9 GeV for p-p scattering at 90° in the c.m. system. It is found that $R = 0.11 \pm 0.16$, $A' = -0.54 \pm 0.16$, and $D = 0.91 \pm 0.21$, where these parameters are defined in the c.m. system. The possibility of a vector character for the strong interactions is discussed. It is concluded that neither a single vector-meson exchange nor a single pseudoscalar-meson exchange can account for the data. Spin effects are found to remain an important part of the nucleon-nucleon interaction at four-momentum transfer $-t = 1.8$ (GeV/c)^2. (auth)

25523 DIFFERENTIAL PRODUCTION CROSS SECTIONS OF LOW-MOMENTUM PARTICLES FROM 12.3-GeV/c PROTONS ON BERYLLIUM AND COPPER. Marmer, G. J. (Ohio State Univ., Columbus); Reibel, K.; Schwartz, D. M.; Stevens, A.; Winston, R.; Wolfe, D.; Rush, C. J.; Phillips, P. R.; Swallow, E. C.; Romanowski, T. A. Phys. Rev., 179: 1294-1300(Mar. 25, 1969).

Measurements of the differential production cross sections of pions, kaons, protons, and antiprotons from 12.3-BeV/c protons incident upon copper and beryllium targets were made at the Zero-Gradient Synchrotron at Argonne National Laboratory. These measurements were taken at production angles between 0 and 11.2° and covered the momentum range 500 to 1030 MeV/c. The particles were detected by a time-of-flight technique, supplemented by Cherenkov counters for kaons and antiprotons. (auth)

Strong (Meson-Induced)

25524 (AD–677067) NEGATIVE-PION–PROTON ELASTIC SCATTERING AT 180 DEGREES FROM 1.6 TO 5.3 GeV/c. Kormanyos, Stephen W. (Michigan Univ., Ann Arbor. Dept. of Physics). Apr. 1967. Contract Nonr-1224(23). 79p. (TR–28-03106-28-T). CFSTI.

The differential cross section was measured for negative-pion-proton elastic scattering at 180° in steps of 0.10 GeV/c or less in the region from 1.6 to 5.3 GeV/c. There is considerable structure in the cross section. This may be interpreted as an interference effect between the resonance amplitude and the nonresonant or background amplitude. There is a dramatic destructive interference at Po = 2.15 GeV/c which is quite interesting as the cross section drops almost two orders of magnitude in this region. Another interesting feature of the experiment is the large narrow peak in the cross section at Po = 5.12 GeV/c. It is believed that this is firm evidence for the existence of a nucleon resonance with a mass of (3245 ± 10) MeV. This N*(3245) has a full width at half-maximum of less than 35 MeV. The width of the resonance is about 1% of its mass. Parities and the quantity $X\ (J + \frac{1}{2})$ are given for various N* resonances where X is the elasticity and J is the spin of the resonance. (auth) (USGRDR)

25525 (CERN-Trans–68–17) EXPERIMENTAL STUDY OF THE MECHANISM OF THE REACTION $^{12}C(\pi^-, \pi^- p)^{11}B$ AT 1.04 GeV/c. Agan'yatts, A. O.; Bayukov, Yu.; Vorob'ev, L. S.; (and others) (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). Translated into French by E. Osteletsky (CERN, Geneva), from report ITEF–610. 20p. (In French). Dep.

An abstract of this paper, prepared from the original language, appeared as NSA 22: 50552.

25526 (ORNL-tr–1926) EXPERIMENTAL SITUATION ON ELASTIC π-NUCLEON SCATTERING BELOW 2 GeV. Bareyre, Pierre; Bricman, Claude; Villet, Gerard (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Translated for Oak Ridge National Lab., Tenn., from report CEA-R–2401. 34p. Dep. CFSTI.

Experimental results from various studies of $\pi^\pm + p$ interactions are presented. These data concern the total cross sections, elastic and charge exchange distributions, the polarization of the recoil proton in elastic scattering and coherence of the method of determination of $C_n^{+,-,0}$ and $D_n^{+,-}$. (J.F.P.)

25527 MESON-INDUCED PRODUCTION OF MESONS AND DOUBLE CHARGE EXCHANGE OF π^- MESONS ON NUCLEI OF EMULSION IN THE ENERGY INTERVAL FROM 210 UP TO 375 MeV. Batusov, Yu. A.; Bunyatov, S. A.; Dalkhazhav, N.; Ionitse, G.; Loznyanu, E.; Mikhul, V.; Sidorov, V. M.; Tuvdendorzh, D.; Yarba, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 9: 378-81(Feb. 1969). (In Russian).

Double charge exchange of π^- mesons was investigated at the energies higher than the meson-production threshold. The meson-production cross sections were measured for the reactions $\pi^- + A \rightarrow \pi^+ + A' + \ldots$ and $\pi^- + A \rightarrow \pi^+ + \pi^- + A' + \ldots$. Double charge exchange cross sections for π^- mesons with energies from 210 up to 375 MeV are obtained. (auth)

25528 CROSS SECTIONS OF INELASTIC INTERACTION OF PIONS WITH NUCLEI. Demidov, V. S.; Kirillov-Ugryumov, V. G.; Komarov, V. N.; Ponosov, A. K.; Protasov, V. P.; Sergeev, F. M. (Moscow Engineering-Physics Inst.). Yadern. Fiz., 9: 292-5(Feb. 1969). (In Russian).

Cross sections of neutral strange particles production by 3.86 GeV/c pions were studied by means of 105 cm freon bubble chamber. The total cross section of interaction with internuclear nucleon and cross sections for the nuclei of C, F, and Cl were calculated from measured mean free path of π^--mesons up to inelastic interaction in freon mixture. (auth)

25529 A SEARCH FOR THE C-VIOLATING MODE $e^+e^-\pi^0$ IN THE DECAY OF THE ETA MESON. Zacher, Albert Richard. Princeton, N. J., Princeton Univ., 1968. 130p.

Thesis.

In a deuterium bubble chamber experiment at the Princeton-Pennsylvania Accelerator, 550,000 pictures were examined for eta meson decays of the C-violating type $\eta \rightarrow e^+ e^- + \pi^0$ and the Dalitz conversion type $\eta \rightarrow e^+ + e^- + \gamma$. Eta mesons were produced in the 15-inch fast-cycling bubble chamber by an 820 MeV/c π^+ beam, through the reaction $\pi^+ + d \rightarrow p + p + \eta$. Picture preselection by a counter array was used to reduce the number of pictures to be scanned. A tantalum plate inside the bubble chamber converted gamma rays and helped identify electrons from the decays. The effective size of the eta meson sample was 3900 decays, as determined by normalization to 102 observed events of the type $\pi^+ + d \rightarrow p + p + \pi^0$ with $\pi^0 \rightarrow e^+ + e^- + \gamma$. Eleven events including an estimated background of two events, were consistent with $\eta \rightarrow e^+ + e^- + \gamma$; seven of these were also consistent with $\eta \rightarrow e^+ + e^- + \pi^0$. However, a likelihood calculation using the invariant mass spectrum of the decay electron pairs gives an upper limit $\Gamma(\eta \rightarrow e^+ + e^- + \pi^0)/\Gamma(\eta) < 0.13 \times 10^{-2}$ with 90% confidence,

consistent with C invariance. For the Dalitz decay $\eta \rightarrow e^+ + e^- + \gamma$ we find that both the observed branching ratio, $\Gamma(\eta \rightarrow e^+ + e^- + \gamma)/\Gamma(\eta \rightarrow \gamma + \gamma) = (0.93 \pm 0.4) \times 10^{-2}$, and the observed distribution of the (e^+e^-) invariant mass are consistent with theoretical predictions. (Disser. Abstr.)

25530 PRODUCTION AND DECAY OF CASCADE HYPERONS. Dauber, Philip M.; Berge, J. Peter; Hubbard, J. Richard; Merrill, Deane W.; Muller, Richard A. (Univ. of California, Berkeley). Phys. Rev., 179: 1262-85(Mar. 25, 1969).

The production of cascade hyperons by K^- incident on hydrogen was studied at beam momenta of 1.7, 2.1, and 2.4 to 2.7 GeV/c. A sample of 3028 Ξ^- and 934 Ξ^0 was obtained. Cross sections and polarization for Ξ^-K^+ and Ξ^0K^0 production are presented. The data are compatible with dominance by I = 0 baryon exchange in Ξ^-K^+ production, but also provide strong evidence for resonance formation in the s channel compatible with $Y_1^*(2100)$. Copious production of $\Xi^*(1530)$ and $K^*(890)$ is observed in the three- and four-body final states. A broad $\Xi\pi$ enhancement is observed in the $\Xi^-K^+\pi^0$ and $\Xi^0K^+\pi^-$ final states at a mass near 1894 MeV/c^2 and with a width of about 98 MeV/c^2. This enhancement is identified with the $\Xi^*(1930)$ first observed by Badier et al. Lifetime measurements give $\tau_{\Xi^-} = (1.61 \pm 0.04) \times 10^{-10}$ sec and $\tau_{\Xi^0} = (3.07^{+0.32}_{-0.28}) \times 10^{-10}$ sec. A decay-parameter analysis assuming spin $\frac{1}{2}$ yields $\alpha_{\Xi^-} = -0.391 \pm 0.045$, $\alpha_{\Xi^0} = -0.43 \pm 0.09$, $\Phi_{\Xi^-} \equiv \tan^{-1}(\beta/\gamma)_{\Xi^-} = -(14 \pm 11)°$, and $\Phi_{\Xi^0} = (38 \pm 19)°$ if $\alpha_\Lambda = 0.647$ is used. These results are in agreement with T invariance and the $|\Delta I| = \frac{1}{2}$ rule. A compilation of LRL results for Ξ^- and Ξ^0 yields $\alpha_\Xi = -0.380 \pm 0.034$ and $\Phi_\Xi = -(1 \pm 7)°$, implying $\Delta = \tan^{-1}(-\beta/\alpha)_\Xi = (178 \pm 16)°$. Hence the final-state $\Lambda\pi$ phase difference $\delta_s - \delta_p = -(2 \pm 16)°$ if T is strictly conserved in the decay. Two examples of $\Xi^- \rightarrow \Lambda e^- \bar{\nu}$ were observed. Upper limits $\approx 1 \times 10^{-3}$ have been set for the branching fractions of other $|\Delta S| = 1$ and $|\Delta S| = 2$ leptonic and nonleptonic decays of Ξ^- and Ξ^0. (auth)

25531 LAMBDA POLARIZATION IN $K^-n \rightarrow \Lambda\pi^-$ AT 4.5 GeV/c. Yen, W. L.; Ammann, A. C.; Carmony, D. D.; Eisner, R. L.; Garfinkel, A. F.; Gutay, L. J.; Lakshmi, R. V.; Miller, D. H.; Tautfest, G. W. (Purdue Univ., Lafayette, Ind.). Phys. Rev. Lett., 22: 963-6(May 5, 1969).

An analysis is given of 236 events (102 ± 15 μb) of the reaction $K^-n \rightarrow \Lambda\pi^-$ at an incident momentum of 4.5 GeV/c. The lambda polarization is large and positive up to a squared four-momentum transfer of -2.0 (GeV/c)^2. The differential cross section has a dip near $-t = 0.4$ (GeV/c)^2. The differential cross section for 87 events of the reaction $K^-n \rightarrow \Sigma^0\pi^-$ is also shown corresponding to a total cross section of 39 ± 10 μb. (auth)

25532 EVIDENCE FOR AN I = $\frac{5}{2}$ BARYON RESONANCE OF MASS 1640 MeV/c^2. Benvenuti, A. (Univ. of Minnesota, Minneapolis); Marquit, E.; Oppenheimer, F. Phys. Rev. Lett., 22: 970-2(May 5, 1969).

Evidence is presented to confirm the existence of an I = $\frac{5}{2}$ baryon resonance at 1640 MeV/c^2. The resonance is observed in the reaction $\pi^-d \rightarrow pn\pi^-\pi^-\pi^+$ at 2.6 GeV/c and is found to decay into $n\pi^-\pi^-$ possibly via $\Delta^-(1236)\pi^-$. It is shown that the observed peak cannot be due to kinematical effects such as those responsible for the I = $\frac{5}{2}$ enhancement at $\approx$1580 MeV/c^2 observed earlier. (auth)

25533 A NOTE ON $\pi\pi$ SCATTERING IN THE REACTION $\pi^-p \rightarrow \pi\pi N$. Tuli, S. K. (Banares Hindu Univ., India). Proc. Indian Acad. Sci., Sect. A, 69: 42-7(Jan. 1969).

The production of the di-pion system in the ρ mass region is considered as a $\pi\pi$ scattering process. The experimental results are interpreted in terms of a strong T = 0 s-wave besides the T = J = 1 characteristic of ρ. A numerical estimate of δ_{00} is presented and the question of its variation examined. (auth)

Particle Interactions and Properties (Theoretical)

Refer also to abstracts 25781 and 25789.

General

Refer also to abstract 25170.

25534 (CALT-68-182) CROSSING MATRICES FOR SU(2) AND SU(3). Slansky, Richard; Rebbi, Claudio (California Inst. of Tech., Pasadena). Jan. 22, 1969. Contract AT(11-1)-68. 29p. (CTSL-IR-42). Dep. CFSTI.

A pedestrian derivation of the SU(2) and SU(3) crossing matrices is given. The phases and phase conventions are discussed in detail without using the apparatus of field theory. A number of crossing matrices are computed. (auth)

25535 (CERN-69-7, pp 361-9) ANOMALOUS PROPERTIES OF THE AXIAL VECTOR CURRENT. Zumino, Bruno (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France). New York Univ., N. Y.).

The Dirac equation for a spinor, under the influence of an external electromagnetic potential, and the adjoint equation are considered. These two equations can be combined in a standard way, to give a conservation equation for the vector current and a partial conservation equation for the axial vector current. When an attempt is made to verify these equations in perturbation theory the second equation is not satisfied whenever the spinors are coupled to vector fields. This difficulty, which arises from the triangle diagram, is discussed. A model for the strong interactions which is given by renormalizable Lagrangian theory with PCAC is considered. (J.F.P.)

25536 (DESY-69/2) SOME REMARKS ON CURRENT-FIELD COMMUTATORS. Genz, H.; Katz, J. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Jan. 1969. 20p. Dep.

Implications of the Jacobi identity and Lorentz invariance in the study of equal-time current-field and current-current commutators are discussed. It is shown that these commutators are related by means of the Jacobi identity. Assuming Lorentz invariance it is then proven that equal time commutators between space components of conserved currents and spinor fields do not have Schwinger terms, provided the same holds for their time components. Moreover, the commutators between the time derivatives of space components of these currents and the field can only have first order Schwinger terms. These results are also obtained for nonconserved currents whose divergences commute at equal times with the field. In general, equal time commutators between divergences of currents (or their time derivatives) and fields cannot have first (second) order Schwinger terms. Connections with usual quark and field algebra relations are discussed. (auth)

25537 (JINR-P2-4260) BEHAVIOR OF DIFFRACTION PEAK FOR ARBITRARY SPIN PARTICLES. Nguyen Ngoc Thuan (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 6p. (In Russian). Dep.

Earlier studies of the author and A. A. Logunov, involving the determination of the width of the diffraction peak of particles with the participation of scalar particles $a + b \rightarrow a + b$ (I) and $a + b \rightarrow c + d$ (II), in which it was shown that $\Delta^{I,II}$ cannot decrease faster with increasing s(square of the energy) than const/$\ln^2 s$, were followed up, showing that this behavior applies also to the case of particles with spins. An explicit expression was derived in the above function defining s. As an example, elastic scattering processes were examined, resolving the invariant spiral amplitudes into partial waves. (TTT)

25538 RESTRICTIONS ON SCHWINGER TERMS DUE TO LORENTZ COVARIANCE. Gupta, V.; Rajasekaran, G. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., B10: 11-16(1969).

The commutation relations of the vector and axial-vector current densities are considered. Assuming that the commutators of the time components are given (with no Schwinger terms) the conditions imposed by covariance on the Schwinger terms in the commutators of the space-time and space-space components of the currents are derived. (auth)

25539 THE TAMAID-BACH THEORY. Swart, E. R. Chem. Ind. (London), No. 16, 512-14(Apr. 19, 1969).

Additional comments are made on the criticisms of the Lewis tamaid-bach theory by Swart (loc. cit. 126: 1969) and Lewis reply (loc. cit. 129: 1969). (UK)

25540 SPECTRAL DENSITY SUM RULES, CURRENT ALGEBRA, AND ZERO-MASS EXTRAPOLATIONS. Dooher, J. (Adelphi Univ., Garden City, N. Y.). Phys. Rev., 179: 1530-8(Mar. 25, 1969).

The new spectral sum rule $\int_0^\infty \rho_\pi^{(0)}(\mu^2)d\mu^2 = \int_0^\infty [\rho_\pi^{(1)}(\mu^2)/\mu^2]d\mu^2$ is derived under the assumption that there exists a unique limit in which all masses are zero for the $A_1\rho\pi$ and $\rho\pi\pi$ decay amplitudes. In this sum rule, $\rho_\pi^{(0)}(\mu^2)$ is the pseudoscalar spectral function and $\rho_\pi^{(1)}(\mu^2)$ is the axial-vector spectral function, both of which occur in the Källén-Lehmann representation of the propagator of the π-type axial-vector current. An experimental test of this sum rule is proposed. The equivalent sum rule for K-type axial-vector currents is derived from considerations of the ϕKK amplitude, and applications of these sum rules in conjunction with the first Weinberg sum rules are discussed. In particular, it is found that $f_K/f_\pi = 1$ for the pion and kaon decay amplitudes. (auth)

25541 NON-LAGRANGIAN MODELS OF CURRENT ALGEBRA. Wilson, Kenneth G. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 179: 1499-1512(Mar. 25, 1969).

An alternative is proposed to specific Lagrangian models of current algebra. In this alternative there are no explicit canonical fields, and operator products at the same point [say, $j_\mu(x)j^\mu(x)$] have no meaning. Instead, it is assumed that scale invariance is a broken symmetry of strong interactions, as proposed by Kastrup and Mack. Also, a generalization of equal-time commutators is assumed: Operator products at short distances have expansions involving local fields multiplying singular functions. It is assumed that the dominant fields are the SU(3) × SU(3) currents and the SU(3) × SU(3) multiplet containing the pion field. It is assumed that the pion field scales like a field of dimension Δ, where Δ is unspecified within the range $1 \leq \Delta < 4$; the value of Δ is a consequence of renormalization. These hypotheses imply several qualitative predictions: The second Weinberg sum rule does not hold for the difference of the K* and axial-K* propagators, even for exact SU(2) × SU(2); electromagnetic corrections require one subtraction proportional to the $I = 1$, $I_z = 0$ σ field; $\eta \rightarrow 3\pi$ and $\pi_0 \rightarrow 2\gamma$ are allowed by current algebra. Octet dominance of nonleptonic weak processes can be understood, and a new form of superconvergence relation is deduced as a consequence. A generalization of the Bjorken limit is proposed. (auth)

25542 OVERLAPPING RESONANCES IN THREE-PARTICLE FINAL STATES: COMMENTS AND CORRECTIONS. Snoke, J. Arthur (Yale Univ., New Haven). Phys. Rev., 179: 1620-2 (Mar. 25, 1969).

Comments are made on some of the conclusions drawn in a paper by Chen-Cheung and Sommerfield. It is shown that when calculating total cross sections, resonances can be treated as particles in final states containing overlapping resonances. Other corrections to that paper are included which are mostly of a typographical nature. (auth)

25543 DESCRIPTION OF MASSLESS PARTICLES. Nelson, T. J.; Good, R. H. Jr. (Ames Lab., Iowa). Phys. Rev., 179: 1445-9(Mar. 25, 1969).

A first-order manifestly covariant wave equation is given for massless particles and antiparticles of helicity −s and +s, where $s = 1, \frac{1}{2}, \ldots$. Also, a position operator is defined that has the correct commutation rules and has a sensible time derivative. (auth)

Electromagnetic

Refer also to abstracts 25165, 25577, 25581, 25597, 25602, 25656, 25669, 25693, and 25794.

25544 (BMwF-FBK-68-60) FORM-FACTORS IN BOOTSTRAP-FORMALISM. Rosenthal, P. (Marburg Univ. (West Germany). Institut fuer Theoretische Physik). Dec. 1968. 61p. (In German). Dep.

The electromagnetic form factors of elementary particles are discussed in connection with the bootstrap mechanism for the strong interactions. After describing the general approach given recently by Dashen and Frautschi the simple case of the pion form factor is treated schematically. Here, amplitudes with a virtual (iso-vector) photon can be combined with the π-ρ model of the pion to yield a "bootstrap" relation for the form factor. (auth)

25545 MAGNETIC MULTIPOLE AMPLITUDES OF THE PION PHOTOPRODUCTION AT LOW ENERGIES. Govorkov, B. B. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 9: 413-15(Feb. 1969). (In Russian).

Analysis of the angular dependence of the neutral pion photoproduction on carbon nuclei at 154 MeV results in the expression of combination of magnetic quadrupole amplitude of photoproduction on nucleons via dipole amplitudes: $3M_{2+} + 2M_{2-} = (-0,021 + 0,007)(2M_{1+} + M_{1-})$. The result obtained is in agreement with calculations made using the dispersion theory and weakly depends on the internuclear distribution of nucleon density. (auth)

25546 EFFECT OF POLARIZATION OF INTERMEDIATE BOSONS IN PROCESSES $e^- + e^+ \rightarrow e^+ + W^- + \nu_e$ ON ANGULAR DISTRIBUTION OF MUONS FROM THE W-BOSON DECAY. Choban, E. A. (Leningrad Polytechnic Inst.). Yadern. Fiz., 9: 392-9(Feb. 1969). (In Russian).

Angular distributions of muons from the decay $W^- \rightarrow \mu^- + \bar{\nu}_\mu$ are considered for the W bosons produced in $e^- + e^+ \rightarrow e^+ + W^- + \nu_e$ processes. It is shown that the muon angular distributions related to the momenta of the initial electrons have manifest anisotropy for both the processes, even though the W bosons are produced mainly near the threshold. The polarization vector and the alignment tensor for the W boson are obtained. It is shown that the reason of the anisotropy is in the large value of polarization parameters of the W bosons, main contribution to the anisotropy being due to the diagonal components of the alignment tensor. (auth)

25547 OFF-MASS-SHELL EFFECTS IN BREMSSTRAHLUNG AMPLITUDE. Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 9: 400-8(Feb. 1969). (In Russian).

First three terms in the expansion of the bremsstrahlung amplitude on the photon energy are obtained in framework of the nonrelativistic quantum mechanics. It is shown that the off-mass-shell effects are absent in the bremsstrahlung amplitude in case of collision of two identical particles, with the gyromagnetic ratio $g = 1$. (auth)

25548 SOME THEORETICAL ASPECTS OF PROTON–PROTON BREMSSTRAHLUNG. Signell, Peter (Michigan State Univ., East Lansing). pp 287-304 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 1. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.1).

Recent developments which explain the discrepancies among the various theoretical calculations for proton–proton bremsstrahlung are considered. A discussion of low-energy kinematics, low-energy dynamics mainly in the model-independent effective range region, and a brief discussion of remaining problems are presented. (J.F.P.)

25549 NUCLEON–NUCLEON BREMSSTRAHLUNG. Pearce, William A.; Gale, William A.; Duck, Ian M. (Rice Univ., Houston, Tex.). pp 323-36 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 1. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.1).

The cross section for nucleon–nucleon bremsstrahlung was calculated, the Tabakin separable potentials were used to treat the first-order diagrams. Second-order effects were estimated using simple nuclear forces. (J.F.P.)

25550 INVARIANT AMPLITUDES AND THIRD-ORDER LOW-ENERGY THEOREM FOR NUCLEON COMPTON SCATTERING. Jones, H. F.; Scadron, M. D. (Imperial Coll. of Science and Tech., London). Nucl. Phys., B10: 17-26(1969).

Invariant amplitudes free of kinematic singularities and constraints are found for nucleon Compton scattering. Using these amplitudes and exploiting crossing symmetry it is shown that the low-energy theorem can be extended through third order in the photon energy. (auth)

25551 A CLASSICAL MECHANICS OF FINITE PRECISION AND ITS RELATION TO THE SCHROEDINGER EQUATIONS. Liebowitz, B. Nuovo Cim., Suppl., 6: 1250-76(1968).

The discussion of classical mechanics of finite precision and its relation to the Schroedinger equation covers quantum concepts in classical theory, mechanics of finite precision, an introduction of complex state functions and rotating coordinate systems, and the derivation of a time-dependent equation. A classical electron model is outlined. In this model the calculated angular momentum of the electron is $\hbar/2$ with a discrepancy of a few percent. (J.F.P.)

25552 ANALYSIS OF ANGULAR DISTRIBUTIONS FOR THE PROCESS $\gamma p \rightarrow n\pi^+$ IN THE REGION OF 230 TO 350 MeV. Aleksandrov, Yu. M.; Grushin, V. F.; Leikin, E. M. (Lebedev Inst. of Physics, Moscow). Nucl. Phys., B10: 145-50 (1969).

The results of the phenomenological analysis of the positive photopion angular distributions are presented for the photon energies 230, 260, 290, 320, and 350 MeV. Along with the Moravcsik fit a new form of fitting is used. (auth)

25553 CALCULATION FOR THE $e^+e^- \rightarrow \pi^0\gamma$ REACTION. Cremmer, E.; Gourdin, M. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nucl. Phys., B10: 179-89 (1969).

The cross section for the annihilation $e^+ + e^- \rightarrow \pi^0 + \gamma$ is calculated in a model. A prediction is made for the $\rho^0 \rightarrow \pi^0 + \gamma$ decay width and a particular interest is devoted to the ρ-meson ω-meson interference. (auth)

25554 NUCLEON ELECTROMAGNETIC FORM FACTORS AND THE ρ^0, ω, AND φ RESONANCES. Wataghin, Vladimir (Stanford Univ., Calif.). Nucl. Phys., B10: 107-17(1969).

A solution for the problem of expressing the four electromagnetic form factors of the nucleon in terms of the ρ^0, ω and φ resonances is proposed. The asymptotic behavior and analyticity properties of the solution are determined. The agreement with experiment is excellent. (auth)

25555 CONNECTION OF THE DEUTERON FORM FACTOR WITH THE PHYSICAL S-MATRIX. Shirokov, Yu. M. (Stekloff Mathematical Inst., Moscow); Troitskii, V. E. Nucl. Phys., B10: 118-24(1969).

Using a method developed previously the electrical form factor of the deuteron is expressed in terms of the phase shift of the neutron-proton scattering taken in the physical region only. The anomalous cut contribution is calculated exactly. The contributions of the other singularities are neglected. No arbitrary subtraction constants enter the final result. (auth)

25556 THE ELECTROMAGNETIC MASS DIFFERENCE OF K MESON DUE TO A SIMPLIFIED TADPOLE AND $\pi_V \rightarrow 2\gamma$. Miura, Kimio (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto), 40: 1446-7(Dec. 1968).

It is shown that a simplified tadpole π^0_V contributes negatively to the electromagnetic mass difference $\Delta\mu(K^+ - K^0)$ under the assumptions of the field-current identity hypothesis and SU(6) invariance. The decay rate $\Gamma(\pi_V \rightarrow 2\gamma)$ is also calculated. (L.B.S.)

25557 PHOTON-VECTOR-MESON ANALOGY MODEL AND ITS APPLICATION TO $\gamma + N \rightarrow \gamma + B$ AND $\gamma + N \rightarrow V + B$ PROCESSES. Iso, Chikashi; Yoshii, Hiroaki (Tokyo Inst. of Tech.). Progr. Theor. Phys. (Kyoto), Suppl. Extra No., 11-16(1968).

The general relations among differential cross section, polarization, helicity, density matrix-element and joint decay helicity density matrix-element and joint decay helicity density matrix element in $\gamma + N \rightarrow \gamma + B$ and $\gamma + N \rightarrow V + B$ processes are given under photon-vector-meson analogy model. The prediction for the differential cross section of proton Compton scattering is given. (auth)

25558 SYNCHROTRON RADIATION. Sokolov, A. A.; Ternov, I. M. Oxford, Pergamon Press Ltd., 1968. 207p. £6; $16.00.

Translation by M. August and H.-R. Kissener.

The fundamental problems of the theory of synchrotron radiation is presented in a systematic manner. A detailed theoretical analysis of its peculiar features is presented in the framework of both classical and quantum theory. Particular attention is devoted to a number of questions concerning the peculiarities of electron motion with reference to the quantum fluctuations of the emission. A supplementary chapter dealing with experimental studies of the properties of synchrotron radiation is also included. (L.B.S.)

25559 VECTOR-MESON DOMINANCE AND HIGH-ENERGY ELECTRON–PROTON INELASTIC SCATTERING. Sakurai, J. J. (Univ. of Chicago). Phys. Rev. Lett., 22: 981-4(May 5, 1969).

A vector-meson dominance model for high-energy ep inelastic scattering is proposed. It is predicted that at high values of the missing mass (>2.5 BeV) the ratio of the longitudinal to the transverse cross section is given by $\xi(q^2/m_\rho^2)[1 - (q^2/2m_p\nu)]^2$, where ξ is expected to be of the order of unity. Scale invariance (in the sense of Bjorken) is satisfied at very high q^2. The model may adequately account for the remarkably large cross section recently observed in the deep inelastic region. (auth)

25560 PROBES FOR THE CONSTITUENTS OF THE ELECTROMAGNETIC CURRENT AND ANOMALOUS COMMUTATORS. Jackiw, R.; Preparata, G. (Harvard Univ., Cambridge, Mass.). Phys. Rev. Lett., 22: 975-7(May 5, 1969).

It is shown that the Callan–Gross sum rules for electroproduction fail in perturbation theory. Nonperturbative lepton annihilation sum rules are derived. The inapplicability of perturbation theory is traced to the breakdown of the Johnson–Low–Bjorken high-energy theorem. (auth)

25561 COMPUTER ALGORITHMS FOR DIRAC ALGEBRA, RELATIVISTIC e^4-e BREMSSTRAHLUNG AT WIDE ANGLES, AND UNITARITY CONSTRAINTS ON THE MANDELSTAM REPRESENTATION. Swanson, Stanley Mardon. Stanford, Calif., Stanford Univ., 1968. 118p.

Thesis.

A collection of algorithms written in ALGOL 60 is given to illustrate the manipulation techniques used in machine language programs designed for symbolic evaluation of algebraic expressions. It is hoped that this will provide a more understandable and accessible archive for these methods than scattered listings of assembly code for specific computers. The input and distribution of arbitrarily parenthesized algebraic expressions, Chisholm's reduction of the product of traces with intercontracted indices to single traces, the removal of contracted indices in single traces to produce simple traces which are then reduced to invariant dot products (and determinants if γ_5's are present) are considered. Several storage schemes are discussed. A subset of these methods is applicable to ordinary (commutative) algebra. These algorithms were used in the evaluation of the bremsstrahlung spectrum for relativistic positron-electron collisions. The Dirac traces for the exact, lowest-order differential cross section were reduced to invariants on a computer and further simplified (again by computer) until reasonably compact expressions were obtained. The phase-space integrals were evaluated numerically for photon emission angles of roughly 30 to 120° from the incident particles in the c.m. system. Numerical results for selected photon angles and energies are given for 15-BeV positrons incident upon electrons at rest in the laboratory and for 600- and 4000-MeV positrons in the c.m. system (colliding beam experiments). It was found that certain relativistic approximations to the spectrum, valid for forward angles, are still fairly good at wide angles; an empirical modification to such an approximation is given which provides a useful interpolation formula for the wide-angle region. A distinct and short investigation of the structure imposed upon scattering amplitudes by the general quantum mechanical principles of unitarity and crossing symmetry is given. Crossing is built in by working within the Mandelstam representation; results are in terms of the double spectral function in this representation. In the elastic strip, Mandelstam has used unitarity to give the spectral functions as integrals over crossed-channel absorptive parts. The content of this result has been re-expressed by Martin in an equation between inverse power moments of the spectral function and a double integral over absorptive parts with a Legendre function of the second kind, $Q_n(z)$, as kernel. When the moments of the spectral functions are products of gamma functions (roughly, when $\int x^{-n}\rho(s,x)dx \propto \Gamma(n+a)/\Gamma(n+b) \sim n^{a-b}$), rigorous solutions for the spectral function are obtained in terms of generalized hypergeometric functions. In an attempt to extract more information about spectral functions than is given by the optical theorem alone, an amplitude extrapolated from the experimental high-energy behavior of elastic cross sections is used and an estimate is made of the first few terms of the double spectral function for neutral pseudoscalar meson-meson scattering. (Disser. Abstr.)

25562 PERTURBATION THEORY FOR MAGNETIC MONOPOLES. Rabi, Arnulf (Univ. of California, Berkeley). Phys. Rev., 179: 1363-70(Mar. 25, 1969).

The Feynman-Dyson perturbation theory is applied to Schwinger's model of the monopole. The propagator for photon exchange between electric and magnetic charges is found to be $D^{AB}_{\mu\nu}(k) = (k^2+i\epsilon)^{-1} \times (\epsilon_{\mu\nu\lambda\kappa}n^\lambda k^\kappa)/(n\cdot k)$. [In the frame of quantization, $n = (0,\hat{n})$, where $\hat{n}$ is the unit vector in the direction of the singularity line.] Since the exact theory is independent of n, one might try to obtain a manifestly covariant perturbation expansion by averaging over all directions of n. Under such a procedure the Born term reproduces the known nonrelativistic limit, if proper case is taken of the helicity-flip phase factor. (auth)

25563 ISOVECTOR ELECTROMAGNETIC FORM FACTORS. Schwarz, John H. (Princeton Univ., N. J.). Phys. Rev., 179: 1486-91(Mar. 25, 1969).

Isovector electromagnetic form factors are calculated by dispersion-theoretic methods, keeping only the two-pion intermediate states. The pion form factor, which plays a particularly important role, is obtained from effective-range theory and a comparison with data from recent colliding-beam experiments. Annihilation amplitudes ($N\bar{N} \rightarrow \pi\pi$, $K\bar{K} \rightarrow \pi\pi$, etc.) are calculated by a method of pole dominance discussed in a previous paper and a technique for incorporating universality of ρ-meson couplings. Agreement with experiment is achieved for the two isovector radii of the nucleon, even though the calculated form factors do not fall fast enough at high momentum transfer. (auth)

25564 COMPTON SCATTERING FROM BOUND ELECTRONS. Fronsdal, C. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev., 179: 1513-17(Mar. 25, 1969).

An exact analytic expression for the matrix element for elastic Compton scattering from a K-shell electron is obtained by a simple algebraic calculation. (auth)

25565 BEHAVIOR OF HELICITY AMPLITUDES AT A THRESHOLD INVOLVING ONE PHOTON. Jones, Lorella M. (Univ. of Illinois, Urbana). Contract AT(11-1)-68. Phys. Rev., 179: 1627-8(Mar. 25, 1969).

It is shown that there is a simple mnemonic for the threshold kinematic factors of photoproduction processes. The formula is based on angular momentum counting and is similar to the angular momentum arguments used with processes in which all particles are massive. (auth)

25566 SIGN AND MODEL DEPENDENCE OF $\pi^0 \rightarrow 2\gamma$ MATRIX ELEMENT. Okubo, S. (Univ. of Rochester, N. Y.). Phys. Rev., 179: 1629-31(Mar. 25, 1969).

The experimentally established sign of the $\pi^0 \rightarrow 2\gamma$ matrix element is used to discriminate between various models of elementary particles and of the decay mechanism. The quark model seems to be excluded. (auth)

25567 ANOMALOUS MAGNETIC MOMENTS OF NUCLEONS AND SIDEWISE DISPERSION RELATIONS. Ademollo, M. Har-

vard Univ., Cambridge, Mass.); Gatto, R.; Longhi, G. Phys. Rev., 179: 1601-8(Mar. 25, 1969).

A theoretical calculation of the anomalous magnetic moments of the nucleons is presented, based on Bincer's sidewise dispersion relations. Each of the relevant amplitudes is consistently derived in the approximation of keeping only intermediate πN states. The result is obtained in terms of the elastic S_{11} and P_{11} phase shifts. The isoscalar and isovector anomalous magnetic moments are calculated for three alternative models of the phase shifts involved. (auth)

25568 STUDY OF THE KINEMATIC CONSTRAINTS AND FACTORIZATION IN THE REGGE-POLE MODEL FOR PHOTOPRODUCTION PROCESSES. Shih, C. C. (Brookhaven National Lab., Upton, N. Y.); Tung, Wu-ki. Phys. Rev., 179: 1580-9 (Mar. 25, 1969).

By enforcing factorization together with the (kinematic) analyticity requirements on the scattering amplitudes, the pole spectrum and residue-function behavior in the Regge-pole model for several photoproduction processes are analyzed. It is shown that the simultaneous imposition of these requirements in all the reactions related by factorization is sufficient to limit the number of possible solutions to a few general types. In most cases, these solutions correspond exactly to those obtained from the so-called group-theoretical or O(4) schemes. In a few cases, anomalous solutions which do not have any O(4) counterpart are also found. There is no basic distinction between equal- and unequal-mass particles scattering in this approach. (auth)

25569 SPIN-ONE PARTICLE IN AN EXTERNAL ELECTROMAGNETIC FIELD. Shay, D.; Good, R. H, Jr. (Ames Lab., Iowa). Phys. Rev., 179: 1410-17(Mar. 25, 1969).

Equations of motion for a spin-one particle and its antiparticle in an external electromagnetic field are developed using a $(1,0)\oplus(0,1)$ six-component wave function. Anomalous magnetic dipole and electric quadrupole effects are included. The wave equation is manifestly covariant and has no auxiliary conditions. The invariant integral for the system is derived, and the nonrelativistic limit is discussed. The semiclassical approximation for a relativistic spin-one particle in an electrostatic field is set up; then the problem of calculating the change of polarization reduces to a set of three coupled total differential equations. (auth)

25570 BOOTSTRAP EQUATION AND THE CABIBBO ANGLE. Tanaka, K.; Tarjanne, P. (Univ. of Helsinki). Phys. Rev., 179: 1554-9(Mar. 25, 1969).

It is conjectured that the weak and electromagnetic properties of hadrons are determined by self-consistency requirements. Possible solutions of the c-number bootstrap equations $a_i = cd^j_{jk}(a_j a_k + b_j b_k)$ and $b_i = 2cd^j_{jk}b_k$ are studied, where the amplitudes a_i and b_i represent the matrix elements of unitary octet vector and axial-vector charges, respectively, d^j_{jk} is the completely symmetric invariant tensor of the third order, the unitary spin indices run from 1 to 8, and c is an arbitrary constant. When all except the amplitudes a_3 and a_8 are zero, a solution is $a_3 = \sqrt{3}a_8$, which holds for the isoscalar (a_8) and isovector (a_3) components of electromagnetic interaction. When slight deviations from $a_3 = \sqrt{3}a_8$ are considered, the physical Cabibbo angle can be artificially obtained. More general solutions are considered in which the relative sizes of the amplitudes are obtained in closed form but the Cabibbo angle is $\frac{1}{4}\pi$. It appears that one must consider slight deviations from $a_3 = \sqrt{3}a_8$ or include higher-order terms in the amplitudes to obtain the physical Cabibbo angle. (auth)

Weak

Refer also to abstracts 25570, 25595, 25693, and 25846.

25571 (CERN-69-7, pp 197-204) P-WAVE NONLEPTONIC HYPERON DECAYS IN THE QUARK MODEL. Flamm, D.; Majerotto, W. (Oesterreichische Akademie der Wissenschaften, Vienna. Institut fuer Hochenergiephysik).

It is shown that the nonrelativistic quark model including vector meson exchange processes can explain the phases of all p-wave amplitudes. If one includes a dynamical breaking of SU(3) symmetry by using the physical values for the energy of the outgoing meson (π) this model fits all amplitudes well with only two parameters. One of them is the overall normalization constant, the other one can be understood by the quark wave function normalization volume. (J.F.P.)

25572 (CERN-69-7, pp 225-6) THE $\Delta I = 1/2$ RULE IN THE $K \to 3\pi$ DECAY RATES. Bouchiat, C. (Paris Univ., Orsay (France). Faculte des Sciences); Veltman, M. (Paris Univ., Orsay (France). Faculte des Sciences. Utrecht Rijksuniversiteit (Netherlands). Instituut voor Theoretische Fysica).

The idea that, due to the electromagnetic mass shifts and the occurrence of large slopes, the predictions of the $\Delta I = \frac{1}{2}$ rule for the $K \to 3\pi$ decay rates are ambiguous up to about 10% is considered. (J.F.P.)

25573 (CERN-69-7, pp 227-56) LEPTONIC K DECAYS. Rubbia, Carlo (European Organization for Nuclear Research, Geneva (Switzerland)).

A review is given of problems related to leptonic decays of charged and neutral mesons (K). The K_{e3} decay, determination of the Cabibbo angle for K_{e3} decays, the problem of the $K_{\mu 3}$ form factors, and tests of the selection rule $\Delta Q/QS$ for K_{e3} and K_{e4} decays are considered. (J.F.P.)

25574 (CERN-69-7, pp 263-70) REVIEW OF K_{l3} THEORY. Callan, C. (Harvard Univ., Cambridge, Mass. Dept. of Physics).

Theoretical means of studying the form factors for $K^+ \to \pi^0 + e^+ + \nu$ decay are discussed. It is concluded that these theoretical treatments contain such drastic assumptions and approximations that one cannot believe them without detailed experimental confirmation of their predictions. (J.F.P.)

25575 (CERN-69-7, pp 271-7) CORRECTIONS TO THE LOW ENERGY RESULTS OF THE ALGEBRA OF CHARGES. Stech, Berthold (Heidelberg Univ. (West Germany). Institut fuer Theoretische Physik).

The formal part of previous results for obtaining corrections to the low-energy results of the algebra of charges is presented. As an illustration the K_{13} form factor is considered. It is emphasized that the correction to the low-energy results is formally understood and can be derived from the algebra of charges without further assumptions. (J.F.P.)

25576 (CERN-69-7, pp 281-90) APPLICATION OF VENEZIANO MODEL TO K_{l4} DECAY. Roberts, R. G.; Wagner, F. (European Organization for Nuclear Research, Geneva (Switzerland)).

A hadron current is constructed from the Veneziano model using also the well-known soft-pion theorems. The effect of the Veneziano model is seen in the determination of the phases of the form factors, possible enhancements in the form factors, and the prediction of the momentum dependence of the K_{13} form factors. (J.F.P.)

25577 (CERN-69-7, pp 409-26) RADIATIVE CORRECTIONS TO WEAK PROCESSES. Sirlin, A. (New York Univ., N. Y. Dept. of Physics).

The review of radiative corrections to weak processes covers radiative corrections to μ decay, radiative corrections to the electron spectrum in allowed β decay, current algebra calculations of the radiative corrections to the vector amplitude in β decay, and also special models, the possible role of the intermediate boson, attempts to generalize the current algebra results to the axial vector amplitude and finite momentum transfers, generalization of the Bjorken expansion and the role of the commutator $[\delta_0\, j^\mu(\vec{x}),\, j_\mu(0)]$, and theories with $[\delta_0\, j^\mu(\vec{x}),\, j_\mu(0)] =$ c number. (J.F.P.)

25578 (CERN-69-7, pp 485-94) ORIGIN OF THE WEAK INTERACTION ANGLE. Maiani, L. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica. Istituto Nazionale di Fisica Nucleare, Rome (Italy)).

The basic idea in the discussion of the weak interaction angle is that the relative orientation of the weak interactions and of the SU(3) breaking arises from a dynamical interplay of weak, electromagnetic, and strong interactions. From the idea that the leading divergent weak corrections to hadron processes, when summed to all orders, could give rise to effects competitive with strong and electromagnetic effects, a self-consistency condition is formulated ensuring that such corrections as well as the tadpole electromagnetic corrections do not cause a change in the breaking term describing the hadron mass splittings. (J.F.P.)

25579 (CERN-69-7, pp 495-528) WEAK INTERACTIONS AND LOW-ENERGY NUCLEAR PHYSICS. Blin-Stoyle, R. J. (Sussex Univ., Brighton (England)).

The discussion of weak interactions in low-energy nuclear physics covers β decay, nonleptonic weak interactions in the nucleus, the weak interaction potential, and a comparison of theoretical and experimental values for Q_γ, and T violation in nuclear physics. (J.F.P.)

25580 (ITEF-635) ON SOME MODEL OF RENORMALIZABLE WEAK INTERACTION. Shabalin, E. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noit Fiziki). 1968. 22p. (In Russian). Dep.

The model of renormalizable weak interaction formulated by Kummer and Segre for leptonic interactions is extended to hadron-lepton and nonlepton processes. Using methods analogous to those of the current algebra, it is shown that the theory leads to

the equality of the vector constants of the neutron and muon decay. A new solution of the problem of neutral currents is proposed and a criterion of applicability of the model to the nonleptonic weak interactions is presented. The model does not contradict experimental data and has no difficulties of conventional weak interaction theory at high energies. Experiments to check the validity of the model are proposed. (auth)

25581 (JINR-E2-4370) FORM FACTORS AND TOTAL CROSS SECTIONS OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Markov, M. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 9p. (CONF-670660-1). Dep.

From Seminar on the Perspectives in High Energy Physics, Riga, USSR.

A hypothesis is discussed that the total cross sections may approach in their magnitude and energy dependence the corresponding cross section of weak (or electromagnetic) processes calculated under the assumption of point particles. (auth)

25582 POLARIZATION EFFECTS IN NEUTRINO-INDUCED PROCESSES WITH ISOBAR PRODUCTION. Lyul'ka, V. A. (Inst. of Atomic Energy, Moscow). Yadern. Fiz., 9: 388-91 (Feb. 1969). (In Russian).

Some polarization effects for the neutrino-induced isobar production $\nu + N \rightarrow N^* + l$ are considered. Expressions are obtained for cross sections of such reactions in case when the initial nucleon is polarized and the lepton (l) polarization is measured. (auth)

25583 NOTE ON THE PSEUDOSCALAR COUPLING IN THE WEAK INTERACTIONS OF URBARYONS. Kaneko, Takao (Meijo Univ., Nagoya, Japan). Progr. Theor. Phys. (Kyoto), 40: 1456-8(Dec. 1968).

The magnitudes of pseudoscalar coupling in the weak interactions of urbaryons are discussed in terms of experimental values of the branching ratios $\Gamma(\pi^+ \rightarrow e^+\nu)/\Gamma(\pi^+ \rightarrow \mu^+\nu)$ and $\Gamma(K^+ \rightarrow e^+\nu)/\Gamma(K^+ \rightarrow \mu^+\nu)$. (L.B.S.)

25584 SOME CONSIDERATIONS ON THE WEAK INTERACTION. Hayashi, Takemi; Koide, Yoshio; Ogawa, Shuzo; Okonogi, Hisaichiro; Yonezawa, Minoru (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), Suppl. Extra No., 381-91(1968).

Recently a model of the elementary particle was recently proposed with the aim to obtain a unified understanding of the various features of the weak interaction. This model may be regarded as a new version of the modified Nagoya model, which has been arrived from the "model" approach to the elementary particle initiated by the Sakata model. In this paper some problems at the present stage of the model approach to the weak interaction are discussed and a reasoning for the proposed model is presented. (auth)

25585 MAGNETIC MOMENTS OF LEPTONS AND THE LEPTONIC BOSON. Nakamura, Seitaro (Max-Planck-Institut fuer Physik und Astrophysik, Munich); Matsumoto, Hideki; Nakazawa, Nobuya; Ugai, Hiroyuki. Progr. Theor. Phys. (Kyoto), Suppl. Extra No., 422-35(1968).

As a possible pattern of elementary particles the leptonic boson possessing a lepton number is introduced and its contributions to the magnetic moments of the muon and the electron are evaluated. A leptonic boson Z^0 is assumed to couple with the muon and the electron in the Yukawa type interaction: $\mu^- \rightarrow e^- + \overline{Z}^0$, $\mu^+ \rightarrow e^+ + Z^0$ (here μ^+ and e^- are taken as particles). Furthermore, it is assumed that the bosons have the lepton number +2 for Z^0 and −2 for $\overline{Z}^0$. Calculations are done for the case of S (scalar), V (vector), A (axial vector) and P (pseudoscalar) interactions for the Z^0 boson vertex. It is found that only for the P interaction the observed deviations of the magnetic moments of the muon and the electron can be accounted for in so far as the deviations are in the opposite directions with the predicted values of quantum electrodynamics. It is tentatively found that the mass of $\overline{Z}^0$ boson ($M \cong 3.0$ BeV) and the coupling constant for the Z^0 boson vertex ($g^2/4\pi = 8.5 \times 10^{-3}$) explain the anomaly of the magnetic moments of leptons. These results are subject to further observations. The muon pair production by the impact of an electron on a nucleon is expected through the Z^0 boson channel. This process could be a candidate for the source of the anomalous muon components explored in the cosmic ray experiments of ultra high energy. (auth)

25586 A COMMENT ON THE CABIBBO ANGLE DETERMINATION OF GATTO ET AL. Lee, Y. Y. (Univ. of Chicago). Phys. Lett., 28B: 682-3(Mar. 17, 1969).

It is commented that the assumptions used previously to determine the Cabibbo angle, i.e., that the symmetry breaking part of the Hamiltonian is $u_0 + cu_8$ and that with such Hamiltonian the quadratically divergent terms in the weak self mass arising from the intermediate boson cancel out exactly, is objectionable. (auth)

25587 CONSERVATION LAW OR VIOLATION LAW? Machida, Shigeru (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), Suppl. Extra No., 17-27(1968).

An attempt is given, which aims at representing the fundamental laws of weak interactions as conservation laws instead of conventional violation laws. It is assumed that the conserved quantities characteristic to weak interactions are anti-commutable with those characteristic to strong interactions. All weak interactions are assumed to occur via intermediate boson, which is assumed to belong to an eigenstate of the conserved quantities for weak interactions. V−A law is derived in this way by adopting the chirality as one of the conserved quantities. As a conserved quantity the iso-chirality is also adopted, which is defined to be an operator anti-commutable with the iso-parity. Then isospin and hypercharge are not conserved, and $|\Delta I| = 1/2$ rule is derived using weak current composed of bilinear forms of quarks. The Cabibbo angle appears naturally in the general definition of the iso-chirality operator. Also briefly discussed is a possible scheme of leptonic interaction, which satisfies the three conditions; $|\Delta I| = 1/2$ rule for hadronic processes, non-appearance of neutral lepton currents and universality of coupling constants in the primary interaction between intermediate bosons and weak currents. (auth)

25588 CURRENT ALGEBRA ON THE MASS SHELL: LEPTONIC K DECAYS. II. Greenberg, David F. (Carnegie-Mellon Univ., Pittsburgh). Phys. Rev., 179: 1623(Mar. 25, 1969).

The πK scattering amplitude given by chiral Lagrangian techniques is used to modify an earlier construction of axial-vector form factors in K_{l4} decays. (auth)

25589 HADRONIC CORRECTIONS TO THE GOLDBERGER-TREIMAN RELATION. Pagels, Heinz (Rockefeller Univ., New York). Phys. Rev., 179: 1337-44(Mar. 25, 1969).

Using unsubtracted dispersion relations in momentum transfer for the matrix element of the divergence of the axial-vector current between nucleon states, the hadronic continuum corrections to the Goldberger−Treiman relation for π^+ decay were examined. These are observed to be about +10%. From a rigorous unitarity bound and the assumption that the pion propagator $\Delta_\pi(0)$ is dominated by the pion pole it is shown that the continuum states of energy greater than two nucleon masses contribute less than ½%. The $\pi\rho$ and $\pi\sigma$ states contributed negligibly. Using Weinberg's extrapolation for the $\pi\pi$ scattering amplitude and chiral dynamics, it is found that the presumably dominant 3π state contributes with opposite sign and is more than an order of magnitude too small. In the absence of any simple explanation for the 10% correction, it is conjectured that what is required is a 3π threshold enhancement or possible resonance, the tripion, with the quantum numbers of the pion and mass near threshold at 4.2 BeV/c^2 or a possible subtraction in the dispersion relation. (auth)

25590 ASYMPTOTIC SUM RULES AT INFINITE MOMENTUM. Bjorken, J. D. (Stanford Univ., Calif.). Phys. Rev., 179: 1547-53(Mar. 25, 1969).

By combining the $q_0 \rightarrow i\infty$ method for asymptotic sum rules with the $P \rightarrow \infty$ method of Fubini and Furlan, the structure functions W_2 and W_1 in inelastic lepton-nucleon scattering are related to matrix elements of commutators of currents at almost equal times at infinite momentum. It is argued that the infinite-momentum limit for these commutators does not diverge, but may vanish. If the limit is nonvanishing, $\nu W_2(\nu,q^2) \rightarrow f_2(\nu/q^2)$ and $W_1(\nu,q^2) \rightarrow f_1(\nu/q^2)$ as ν and q^2 tend to ∞ are predicted. From a similar analysis for neutrino processes, it is concluded that at high energies the total neutrino-nucleon cross sections rise linearly with neutrino laboratory energy until nonlocality of the weak current-current coupling sets in. The sum of νp and $\bar{\nu}p$ cross sections is determined by the equal-time commutator of the Cabibbo current with its time derivative, taken between proton states at infinite momentum. (auth)

25591 AMELIORATION OF DIVERGENCE DIFFCULTIES IN THE THEORY OF WEAK INTERACTIONS. Gell-Mann, Murray (Inst. for Advanced Study, Princeton, N. J. California Inst. of Tech., Pasadena); Goldberger, Marvin L.; Kroll, Norman M.; Low, Francis E. Phys. Rev., 179: 1518-27(Mar. 25, 1969).

A new approach to the problem of the singularity of the weak interactions is presented. Its aim is to provide a theoretical interpretation of the extreme smallness of the violation of selection rules associated with the weak-vector-current operator appearing in the conventional Fermi or intermediate-vector-boson interaction Lagrangian. To illustrate it is noted that on account of this singular character, the conventional theories have not yet yielded an understanding of the weakness of strangeness and parity violation in hadronic processes and the weakness of semileptonic neutral decays. An interaction Lagrangian is used in which the constituents of the conventional weak current (e.g.,

strangeness-changing, axial-vector, muonic, etc). are coupled to possibly distinct local vector operators. This is done in such a way that the effective weak interaction between two currents decomposes into two parts, one having the universality of the weak interaction, the other, called diagonal, acting only between a constituent and itself. It is then possible to transfer the singularity of the weak interaction to the diagonal interaction and to impose any desired degree of symmetry upon the singular part of the diagonal interaction. Two realizations of this approach are presented. Both are intermediate-boson theories involving gradient-coupled spin-0 bosons as well as spin-1 bosons. An important consequence of these theories is that, apart from implying a lower bound, the weak interactions give no indication of the magnitude of the diagonal interactions. Thus while the scattering of μ-neutrinos by electrons should be governed by the conventional universality formula, there is no reason to expect universality to hold for the scattering of e-neutrinos by electrons. (auth)

25592 LEADING DIVERGENCES IN NONLEPTONIC DECAYS. Mohapatra, R. N.; Olesen, P. (Univ. of Rochester, N. Y.). Phys. Rev., 179: 1417-25(Mar. 25, 1969).

It is shown that the leading divergences in weak nonleptonic decays can be expressed in terms of time-ordered products of σ commutators (to all orders in the semiweak coupling constant). Nontrivial criteria is formulated for the σ commutators from which the leading divergencies in strangeness-changing nonleptonic interactions can be shown to vanish in any order. The remaining divergences are then of the same type as those in the radiative corrections. (auth)

25593 NONLEPTONIC AND WEAK-ELECTROMAGNETIC DECAYS OF HYPERONS IN THE POLE MODEL. Ram Mohan, L. R. (Purdue Univ., Lafayette, Ind.). Contract AT(11-1)-1428. Phys. Rev., 179: 1561-6(Mar. 25, 1969).

An estimate is made for the contribution of the decuplet poles to the weak decays of hyperons using the Rarita-Schwinger formalism for spin-$\frac{3}{2}$ fields. SU(3) symmetry is used in conjunction with the Gourdin-Salin model for the D-B-π and D-B-γ couplings. It is shown that the decuplet contribution is large for the parity-violating amplitudes. For weak-electromagnetic decays, this predicts asymmetry parameters which are at variance with earlier calculations. The decay rate for $\Sigma^+ \rightarrow p\gamma$ agrees well with the experimental result. (auth)

Strong (General)

Refer also to abstracts 25629 and 25693.

25594 (CERN-69-7, pp 371-89) STRONG INTERACTION IVB MODELS. Marshak, R. E.; Mohapatra, R. N.; Okubo, S.; Rao, J. Subba (Rochester Univ., N. Y.).

Some of the predictions of two intermediate vector boson models are examined in order to encourage experimental tests of the hypothesis of a strongly interacting W. In one model there is a strong interaction among the hadrons; while in the other model there is solely a strong interaction among the W's. (J.F.P.)

25595 (SU-1206-190) NON-PERTURBATION APPROACH FOR DECAY PROBLEMS. Yamamoto, Kunio (Syracuse Univ., N. Y. Dept. of Physics). Jan. 1969. 11p. (NYO-3399-190). Dep. CFSTI.

A nonperturbation approach for decay problems is presented. The results may be applicable to strong interaction decays provided that the width is sufficiently small. For weak interaction decays, including that of the neutral kaon, all the results are identical with those of perturbation theory. Some discussion is given of the difference between the resonances (decay through strong interaction) and the unstable particles (decay through weak interaction). (auth)

25596 NUMBER OF WAVE FUNCTIONS OF UNSTABLE PARTICLE. Ersak, I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 9: 458-61(Feb. 1969). (In Russian).

Using a natural assumption on the properties of the wave functions describing an unstable particle, the relation between the number of these wave functions and possible decay laws of the particle is obtained. (auth)

25597 COUPLING CONSTANTS AND MAGNETIC MOMENTS OF BARYONS ($S = \frac{1}{2}^+$) AND MESONS ($S = 0^-, 1^-$) IN THE NONLINEAR QUARK THEORY. Bas'yuni, A.; Kurdgelaidze, D. (Moscow State Univ.). Yadern. Fiz., 9: 432-9(Feb. 1969). (In Russian).

Decay constants and magnetic moments of mesons ($S = 1^-$) and baryons ($S = \frac{1}{2}^+$) are obtained based on an equation for mesons and baryons previously derived in terms of the nonlinear quark theory. Magnetic moments of baryons are also obtained in case of SU(3) symmetry violation. (auth)

25598 SELF-CONSISTENCY AND THE ND^{-1} EQUATIONS. Rosdolsky, Hans Georg. Ann Arbor, Mich., Univ. of Michigan, 1968. 171p.

Thesis.

A technique for efficiently doing bootstrap calculations with the ND^{-1} equations is developed. It is shown how, with this technique, most of the bootstrap conditions can be expressed algebraically. Some applications are given. Also included is a discussion of simplified models for the mesons; namely the quark-antiquark and the baryon-antibaryon models. It is concluded the quark-antiquark model is the more reasonable of the two. (Disser. Abstr.)

25599 BREAKDOWN OF ASYMPTOTIC SUM RULES IN PERTURBATION THEORY. Adler, Stephen L.; Tung, Wu-ki (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. Lett., 22: 978-81(May 5, 1969).

It is shown that all of the principal results of the Bjorken-limit technique break down in perturbation theory in the "gluon" model of strong interactions. (auth)

Strong (Baryon No. = 0)

25600 (JINR-P2-4348) RESONANCES AS UNSTABLE SYSTEMS WITH A GREATER NUMBER OF INTERNAL STATES (PHENOMENOLOGICAL THEORY). Lokaichek, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1969. 13p. (In Russian). Dep.

A quantum mechanical description of unstable particles is given. The description is based on the premise that every unstable particle has a greater number of internal states which can mutually change one into the other. (auth)

25601 (UCRL-18665) NOTES ON $\pi\pi$ SCATTERING. III. J PLANE PHENOMENA. Sivers, D.; Yellin, Joel (California Univ., Berkeley. Lawrence Radiation Lab.). Jan. 17, 1969. 38p. Dep.. CFSTI.

The discussion of $\pi + \pi$ scattering covers properties of Legendre functions, a review of Regge poles in the scattering of spinless equal-mass particles, and the J-plane behavior of the Veneziano model for $\pi\pi \rightarrow \pi\pi$ interactions. Partial fraction expansions, the Froissart–Gribov partial wave amplitudes, location of moving poles in the J-plane, fixed poles in the J-plane, and the asymptotic behavior of $\beta(t)$ are also discussed. (J.F.P.)

25602 EQUATIONS OF THE VECTOR MESON IN RELATION TO DESCRIPTION OF THE PHOTON. Beckers, J.; Pirotte, Ch. (Univ., Liege). Physica, 39: 205-12(Aug. 1, 1968). (In French).

The energy eigenvalue problem of the Kemmer formulation for spin one particles is considered following a new point of view in connection with the case of zero rest mass. The equivalence Proca (m = 0-Maxwell and the non-equivalence Kemmer (m = 0)-Maxwell are clearly explained by this method. (auth)

25603 WEINBERG SUM RULES AND THE $f\pi\pi$ VERTEX. Niedermayer, F.; Pocsik, G. (Roland Eoetvoes Univ., Budapest). Nucl. Phys., B10: 35-9(1969).

A spectral function sum rule connecting the $\rho\pi\pi$ and $f\pi\pi$ vertices is found which, in pole dominance approximation, leads to a reasonable value of the $f\pi\pi$ coupling constant. (auth)

25604 VENEZIANO'S MODEL AND CURRENT ALGEBRA SUM RULES IN $\pi\pi$ SCATTERING. Brooker, P. (Oxford Univ.). Nucl. Phys., B10: 59-64(1969).

A Veneziano model for $\pi\pi$ scattering is used to investigate the contribution from higher resonances to the current-algebra sum rules. The slowly convergent Furlan–Rossetti sum rule for isospin two in the crossed channel is shown only to be satisfied within the model if each family of parent plus daughters separately satisfies the sum rule. (auth)

25605 APPLICATION OF FINITE-ENERGY SUM RULES TO PION–PION SCATTERING. Shan, Yueh. Riverside, Calif., Univ. of California, 1968. 77p.

Thesis.

Finite energy sum rules are applied to the process $\pi + \pi \rightarrow \pi + \pi^0$. Through these sum rules, the scattering amplitudes in the low energy region are related to the Regge amplitudes in the high energy region. The low energy scattering amplitudes are expressed by using crossing matrix, in terms of the crossed channel amplitudes. A bootstrap program is set up for the sum rule of isospin one amplitude. In this sum rule, the Regge amplitude only contains the rho trajectory where the low energy amplitudes in the crossed channel are saturated with narrow width rho and f^0 resonances. Based on the combined assumption of SU(3) and exchange degeneracy, rho and f^0 resonances lie on the same (rho) trajectory.

A two-parameter linear form is assumed for the trajectory function. The values of the parameters are obtained by least square minimization procedure. Several functional forms are used for the residue. The parameter representing the intercept of the trajectory is found to be nearly unique within a certain range of the momentum transfer for certain type of the residue function. The parameter representing the trajectory slope is found to vary to a large extent. (Disser. Abstr.)

25606 GEMEL FAMILIES IN THE BETHE–SALPETER EQUATION AND THE PROBLEM OF PION DECOUPLING. Gatto, R. (Univ., Padua. Istituto Nazionale di Fisica Nucleare, Padua); Menotti, P. Phys. Lett., 28B: 668-70(Mar. 17, 1969).

It is proven that in the Bethe–Salpeter equation a Toller pole at $\alpha = N$ (N = integer) implies a "gemel" pole at $\alpha = N - 2$. The existence of a gemel at $\alpha = 2$ would unvalidate the reasoning for the decoupling of a massless pion with M = 0. (auth)

25607 SOFT-PION REACTIONS WITH APPLICATION TO $\bar{p}p$ ANNIHILATION. Uritam, Rein Aarne. Princeton, N. J.: Princeton Univ., 1968. 133p.

Thesis.

Current algebra and PCAC are applied in order to calculate the differential rate for the process $\bar{p}p \to K^+K^-\pi^+\pi^-$, normalized to the $\bar{p}p \to K^+K^-$ rate, in the soft pion limit, for annihilation in flight at vanishing momentum. The calculation proceeds within the framework of soft pion methods; in this approach one derives a relation for an amplitude to low order in all components of the pion momentum—i.e., for the unphysical case—it is then asserted that this form of the amplitude is valid also for low pion momenta in the physical region. In the development one begins with the matrix element of the time ordered product of two axial currents. Using current algebra and PCAC from this a relation between the amplitude for $i \to f + 2\pi$ and two other terms are derived. In the spirit of soft pion calculations only lowest order terms in pion momentum are retained. For that reason one of the terms contributes only when external baryons are present: these pole terms must be explicitly calculated. The other term is related to the $i \to f$ amplitude by a low energy theorem. The net effect is to relate the $i \to f + 2\pi$ amplitude to the $i \to f$ amplitude. These methods are applied to $\bar{p}p$ annihilation. The amplitude for $\bar{p}p \to K^+K^-\pi^+\pi^-$ is calculated. The final answer is displayed as the differential rate for $\bar{p}p \to K^+K^-\pi^+\pi^-$, normalized to the $\bar{p}p \to K^+K^-$ rate, in the soft pion limit, for annihilation in the flight at vanishing momentum. The integral of this is the $\bar{p}p \to K^+K^-\pi^+\pi^-/\bar{p}p \to K^+K^-$ branching ratio. Comparison with experiment involves two considerations. To obtain the branching ratio one must integrate over all values of pion momenta, whereas the theory applies to soft pions. There is not sufficient data to display the experimental spectrum in the five kinematic variables. (Disser. Abstr.)

25608 MESON RESONANCE COUPLINGS IN A FIVE-POINT VENEZIANO MODEL. Bardakci, K. (CERN, Geneva); Ruegg, H. Phys. Lett., 28B: 671-5(Mar. 17, 1969).

Veneziano's model generalized to the five-point function is applied to the processes $K\bar{K} \to 3\pi$ and $K\bar{K} \to K\bar{K}\pi$. Coupling constants of the exchanged resonances are deduced. The results are partial SU(3), $\omega\phi$ and ff′ mixing angles, and a universal relation between spin 2^+ and spin 1^- decays. For the processes $K\bar{K} \to K\bar{K}\pi$, the model is compatible only with G parity conserving couplings, and thus yields pure F coupling for the decay $2^+ \to 1^-0^-$. (auth)

25609 IMPOSSIBILITY OF POSITIVE DOUBLE SPECTRAL FUNCTIONS. Martin, A. W. (Rutgers-The State Univ., New Brunswick, N. J.). Phys. Lett., 28B: 679-81(Mar. 17, 1969).

Strictly positive double spectral functions are shown to be inconsistent with the observed diffraction peaks. But examples of oscillating spectral functions consistent with unitarity and the diffraction peaks are easily produced. (auth)

25610 ALGEBRAIC STRUCTURE OF SUPERCONVERGENCE RELATIONS. Weinberg, Steven (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Rev. Lett., 22: 1023-5(May 12, 1969).

How to express superconvergence relations for pion scattering as statements about the generators X_A of chiral SU(2) ⊗ SU(2) is shown. One of the superconvergence relations has a remarkable algebraic significance: The matrix mJ_γ (where m and J are the mass and spin matrices) is the sum of a chiral scalar and the fourth component of a chiral four-vector. (auth)

25611 CURRENT-ALGEBRA-CONSTRAINED SINGLE-POLE APPROXIMATION TO THE S-WAVE π-π PHASE SHIFTS. Levers, R. G. (Univ. of Alberta, Edmonton). Phys. Rev., 179: 1528-9 (Mar. 25, 1969).

The s-wave I = 0 and I = 2 π-π phase shifts δ_0 and δ_2, incorporating elastic unitarity, are determined by using Weinberg's below-elastic-threshold current-algebra amplitudes (modified to include a crossed-channel I = 2 state) to fix the position and residue of a single-pole approximation to the unphysical cut. For no value of the π-π coupling constant λ does δ_0 pass through 90°, as it may do according to Walker et al. and Malamud and Schlein. (auth)

25612 GENERALIZED POTENTIAL AND BOOTSTRAPS IN THE N/D FRAMEWORK. Coulter, Philip W. (Univ. of California, Irvine). Phys. Rev., 179: 1590-1(Mar. 25, 1969).

In the ρ bootstrap, the generalized potential is usually computed by assuming that the ρ resonance is the main feature of the scattering amplitude in the crossed channels, making the narrow-width approximation, and using crossing symmetry to obtain the generalized potential in the direct channel. A specific example is given to illustrate that one cannot expect to obtain meaningful results by using this method. (auth)

25613 REGGE TRAJECTORIES OF MESONS IN THE QUARK MODEL. Coulter, Philip W. (Univ. of California, Irvine). Phys. Rev., 179: 1592-4(Mar. 25, 1969).

A model in which mesons are produced as quasibound states in the quark-antiquark system is examined by using the multichannel ND^{-1} equations. The ρ meson is considered as a particular example. The parameters of the model can be adjusted to produce the ρ meson with the experimentally observed mass and width. The solution is continued as a function of l to compute the Regge trajectory of the ρ. In contrast to attempts to compute the ρ trajectory by using a single-channel formalism in which the "force" producing the ρ is the exchange of the ρ meson, trajectories can be computed which are approximately linear and have $\alpha_\rho(0) \approx 0.5$. A reason for this difference is presented and the model dependence of the results is examined. The apparently equal slopes of the known Regge trajectories can be explained within this model if the particles on the trajectories are produced as quasibound states in the quark-antiquark system. (auth)

25614 BOOTSTRAP OF ρ-P′ TRAJECTORY USING FINITE-ENERGY SUM RULES. Desai, Bipin R. (Univ. of California, Riverside. Univ. of California, San Diego, La Jolla); Kaus, Peter E.; Shan, Yueh. Contract AT(11-1)-34. Phys. Rev., 179: 1595-1600(Mar. 25, 1969).

Assuming that the trajectories on which ρ and f^0 mesons lie are degenerate [i.e., assuming exchange degeneracy and SU(3) symmetry for the ρ and P′ trajectories], the zeroth-moment finite-energy sum rule is used for I = 1 in the crossed channel of the $\pi\pi$ system. If the I = 2 contribution is ignored and resonance saturation in the direct channel is assumed, then a single trajectory, assumed to be of the form $\alpha(x) = \bar{a} + bx$ (where x = s or t), dominates the direct channel (s channel) at low energies. It is also assumed that a single trajectory dominates the crossed channel (t channel). It is found that for any given t in the sum rule, there is no unique (bootstrap) solution but rather a continuous range of solutions for $\bar{a}$ and b. The solutions depend on the choice of t and are sensitive to the functional form of the residue β. Even with the most complete form of β, a unique bootstrap solution is not possible within the single-trajectory approximation. For a given t, a unique solution is obtained only when b (and m_π) are given a priori. For t's such that $\alpha(t) = 1$, where the results are independent of the functional form of β, if b is assumed to have the experimental value of 1 BeV^{-2}, then $\bar{a}$ turns out to be 0.64, which is close to the experimental value of ≈0.5. For $\alpha(t)$ in the neighborhood of 1, if b varied from 0 to 5 BeV^{-2}, $\bar{a}$ varies only between 0.5 and 0.7. (auth)

25615 DYNAMICAL CALCULATIONS OF PSEUDOSCALAR AND AXIAL-VECTOR MESON PARAMETERS USING THE RELATIVISTIC LIPPMANN–SCHWINGER EQUATION. Boguta, J.; Wyld, H. W. Jr. (Univ. of Illinois, Urbana). Phys. Rev., 179: 1330-7(Mar. 25, 1969).

A multichannel dynamical calculation of pseudoscalar and axial-vector meson parameters is performed using the relativistic Lippmann-Schwinger equation. The channel considered is PV → PV. The potential is computed using the usual Feynman rules and the resulting equations are solved on a computer. The cutoff is fixed by adjusting the output mass of one resonance or bound state or the output width to the experimental value. For $J^P = 0^-$ $m_K = 496$ MeV is fixed and as output $m_\pi = 135$ MeV, $m_\eta = 587$ MeV are obtained. For $J^P = 1^+$, $\Gamma_B = 114$ MeV is fixed and as output $m_B = 1060$ MeV, $m_{Kc^*} = 1310$ MeV, $\Gamma_{Kc^*} = 87$ MeV, $m_H = 975$ MeV, $\Gamma_H = 50$ MeV, $m_{H'} = 1400$ MeV, $\Gamma_{H'} = 43$ MeV are obtained. Furthermore, if $m_{A_1} = 1080$ MeV, $\Gamma_{A_1} = 110$ MeV, $m_D = 1370$ MeV is obtained as a bound state. (auth)

25616 NARROW-RESONANCE MODEL WITH REGGE BEHAVIOR FOR $\pi\pi$ SCATTERING. Shapiro, Joel A. (Univ. of California, Berkeley). Phys. Rev., 179: 1345-53(Mar. 25, 1969).

A model for $\pi\pi$ scattering of the type recently proposed by Veneziano is discussed. It is a narrow-resonance model with exchange-degenerate, linearly rising trajectories, which obeys crossing symmetry and has the proper Regge behavior in all channels. The general form for the amplitude is discussed, and phase shifts, resonance widths, and high-energy diffraction are calculated, assuming the amplitude takes on the simplest of the possible forms. The condition that the partial widths be positive is extensively discussed. The model is also considered as a testing ground for other theories based on the same assumptions, such as finite-energy sum rules and the Schmid-circle hypothesis. (auth)

25617 s-WAVE SCATTERING LENGTHS, $\pi\pi$ DYNAMICS, AND A UNIVERSAL PARTIAL WIDTH FOR A REGGE TRAJECTORY. Patil, Sharashchandra H. (Univ. of Delhi). Phys. Rev., 179: 1405-9(Mar. 25, 1969).

Logunov-Tavkhelidze equations are solved for $\pi\pi$ scattering partial-wave amplitudes. The forces due to exchanges of the experimental ρ and f^0 mesons and a g meson with a somewhat larger width are found to reproduce ρ, f^0, and g reasonably well. The same forces, however, very strongly imply that the I = 0, 2 scattering lengths are both negative. Analysis of positive- and negative-signature trajectories leads to the conclusion that the particles on a given trajectory all have approximately the same width. Implications of this for high-energy scattering are discussed, and are found to be in good agreement with experiment. (auth)

25618 INTERMULTIPLET MASS FORMULAS FOR OCTET BOSONS AND THE SPLITTING OF THE K**(1420). Matsuda, S. (Polytechnic Inst. of Brooklyn); Oneda, S. Phys. Rev., 179: 1301-4(Mar. 25, 1969).

By using an SU(3) ⊗ SU(3) charge algebra and an asymptotic SU(3) approximation for the SU(3) raising and lowering operators, it is pointed out that there may exist a simple regularity among the mass spectra of octet bosons. It is predicted that (mass of I = ½ member of an octet)^2 − (mass of I = 1 member of the same octet)^2 is approximately constant for all octet bosons. This includes the SU(6)-symmetry result $K^2-\pi^2 = K^{*2}-\rho^2$. This inter-multiplet mass formula indicates that if the recently reported splitting of the A_2 resonance is correct, the K**(1420) resonance must also split. This splitting of K**(1420) is also shown to be consistent with the present decay branching ratios of the A_2 and K**(1420) resonances. However, no similar simple argument exists for the f and f' mesons. (auth)

25619 O(4) EXPANSION OF THE BETHE–SALPETER EQUATION FOR $\pi\rho$ SCATTERING. Lipinski, H. M.; Snider, D. R. (Univ. of California, San Diego, La Jolla). Phys. Rev., 179: 1315-26(Mar. 25, 1969).

In the context of the Bethe−Salpeter equation, the properties of the O(4) expansion of the $\pi\rho$ scattering amplitude are studied. It is found that the expansion has the required kinematical singularities. Assuming that the Regge trajectory of the pion has M = 1 at t = 0, the form of the $\pi\pi\rho$ vertex functions is examined for two trajectory-mixing models. It is also shown that the expansion satisfies Carlson's theorem. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 25600, 25659, and 25678.

25620 (DESY-69/4) CURRENT-FIELD COMMUTATORS AND THE BARYON SPECTRUM. Genz, H.; Katz, J.; Wagner, S. (Hamburg Univ. (West Germany). Institut fuer Theoretische Physik (II)). Jan. 1969. 10p. Dep.

The equal-time commutator between the time component of the axial vector current and the baryon field is assumed to be proportional to the field itself. We use the technique of M. Sugawara to fix the proportionality factor r in the commutator. Consideration of the P_{33} resonances $\Delta_\alpha(1236)$ and $\Delta_\beta(1688)$ together with the D_{33} resonance $\Delta_\gamma(1691)$ gives three possible values of $|r|$. Study of the S_{11} resonance $N_4(1709)$ together with the P_{11} baryons $N_1(940)$ and $N_2(1466)$ shows that the experimental decay widths $\Gamma(N_4 \to N_1 + \pi)$ and $\Gamma(N_2 \to N_1 + \pi)$ select $r \approx \pm 1.2$. The value of $|r|$ so obtained is in agreement with that which one can deduce using the Jacobi identity and current algebra. (auth)

25621 THE AMPLITUDE OF THE $\frac{3}{2}, \frac{3}{2}$ ISOBAR PRODUCTION IN THE INELASTIC PION–NUCLEON SCATTERING BELOW 1 GeV. Makarov, M. M.; Sarantsev, V. V.; Gasilova, N. S. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 9: 368-73(Feb. 1969). (In Russian).

Amplitudes of production of the $N^*(\frac{3}{2}, \frac{3}{2})$ isobar in the reaction $\pi^-p \to \pi^+\pi^-n$ are determined at seven values of the pion energy from 360 up to 780 MeV. Within the energy region up to 550 MeV the results are discussed using the data on the phase analysis of the elastic πp scattering. Amplitudes of the isobar production are compared with those of production of other terms of the $\frac{3}{2}^+$ decuplet in the SU(3) symmetry. (auth)

25622 REGGE-POLE MODEL FOR VECTOR MESON PRODUCTION. II. THE REACTION KN → K*N. Dass, G. V.; Froggatt, C. D. (Rutherford High Energy Lab., Chilton, Eng. Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Phys., B10: 151-68(1969).

Regge-pole analyses for the process KN → K*(890)N are considered for data between 2 and 13 GeV/c. Fits including A_2 and conspiratorial/evasive pion contributions are presented for the charge exchange modes which are dominated by π-exchange; contrast between the conspiring and evasive fits is similar to the $\pi N \to \rho N$ case (Part I). Fits presented for the modes $K^{*+} \to K^{*0}p$ include contributions from a conspiring/evasive pion and an effective isoscalar, even signature, natural parity trajectory P'' choosing nonsense at $\alpha = 0$ and with $\alpha_{P''}(0) \approx 0.2$. These modes are dominated by the P'' contribution and so it is difficult to discriminate between the conspiratorial and evasive fits. The energy dependence of K** production is a problem for the Regge-pole model; the data are incompatible with a dominant contribution from P, P', or ω. (auth)

25623 GRAPHICAL ANALYSIS OF THE PION–PION SCATTERING DATA. Presnajder, Peter (Komenskeho Univ., Bratislava). Nucl. Phys., B10: 169-78(1969).

Ashkin graphical analysis is adapted to the case of pion-pion scattering. The analysis provides simple criteria of the consistency of the data. For illustrative purposes it is then applied to some older data on pion-pion scattering which are sometimes believed to give evidence for a narrow σ-resonance. The analysis shows that the data are inconsistent if interpreted on the basis of simplest assumptions. It it is permitted that the S- and P-wave production ratio differs from the prediction of the one-pion-exchange model, the analysis leads to the broad σ-resonance in the T = j = 0 partial wave. (auth)

25624 O(3,1) SYMMETRY AND THE HIGH-ENERGY REACTION $K^+p \to K^{*+}(890)p$. Raghavan, S.; Samiullah, M. (Osmania Univ., Hyderabad, India). Nucl. Phys., B10: 53-8(1969).

The high-energy behavior of the reaction $K^+p \to K^{*+}p$ was analyzed within the framework of O(3,1) symmetry based on the DSS formalism. A fair agreement was found between our theoretical curve and the experimental data. The analysis shows that the pion belongs to the class $j_0 = 1$, $\eta\xi = -1$, $\xi = +1$. The ω meson is taken to belong to the class j = 0, $\eta\xi = +1$, $\xi = -1$. (auth)

25625 SOLUBLE MODEL FOR THE $\pi\Lambda$ INTERACTION. Queen, N. M. (Univ. of Birmingham, Eng.). Nucl. Phys., B10: 89-98(1969).

A simple model for the $\pi\Lambda$ interaction, based on a forward dispersion relation for the inverse amplitude, is formulated. The assumption that the amplitude is dominated in the appropriate energy range by the $Y_1^*(1385)$ resonance leads to definite restrictions on the possible behavior of the amplitude at lower and at higher energies. The asymptotic total cross section calculated from the model is consistent with the quark-model prediction. However, a negative S-wave scattering length is required, in disagreement with each of three alternative (mutually incompatible) predictions. (auth)

25626 O(3,1) SYMMETRY AND THE HIGH-ENERGY REACTION $K^+p \to K^*N^*$. Raghavan, S.; Samiullah, M. (Osmania Univ., Hyderabad, India). Nucl. Phys., B10: 48-52(1969).

The high-energy reaction $K^+p \to K^*N^*$ was investigated using the formalism of Delbourgo, Salam and Strathdee. The pion trajectory was taken to be the one given by Frautschi and Jones. A fit to the experimental data was obtained at $P_{lab} = 3.5$ GeV/c and $P_{lab} = 5$ GeV/c. It is found that the quantum numbers $j_0 = 0$ and $j_0 = 1$ are associated with the pion trajectory. (auth)

25627 NEW ANALYSIS OF THE LOW-ENERGY K^+p SCATTERING DATA. Martin, A. D.; Perrin, R. (Univ. of Durham, Eng.). Nucl. Phys., B10: 125-36(1969).

The elastic K^+p scattering data are analysed with the help of K^+p derivative forward dispersion relations. A unique solution is obtained. From th'is solution the K^+p s-wave scattering length and effective range are found to be respectively $a_s = -0.32 \pm 0.01$ fm, $r_s = 0.31 \pm 0.15$ fm. A consequence of this analysis is that the K^+p dispersion relation prediction for the strange particle coupling constants is somewhat increased. (auth)

25628 CHARGE COMMUTATOR FOR ANY MOMENTUM. Dillenburg, D.; Jacob, G.; Maris, Th. A. J.; Stech, B. (Univ. Federal do Rio Grande do Sul, Porto Alegre, Brazil). Nucl. Phys., B10: 27-34(1969).

The nucleon matrix elements of the charge commutation relations are considered for arbitrary momentum. The resulting expression is exact. The high-momentum limit reduces to the Alder–Weisberger sum rule. For zero momentum the known low-energy result is obtained together with a closed expression for the correction. (auth)

25629 ROPER RESONANCE N(1470) IN THE THREE-QUARK MODEL. Chylek, Petr (Univ. of California, Riverside). Progr. Theor. Phys. (Kyoto), 40: 1453-4(Dec. 1968).

A simple extension of the Dalitz three-quark model is made in which the Roper resonance N(1470) is interpreted as the first radially excited three-quark state. The generalization leads to several consequences which seem to be in good agreement with experiment: spin-parity predictions for $\Sigma(1690)$ and $\Xi(1930)$; prediction of existence of $\Lambda(1700)$ with spin-parity $\frac{1}{2}^+$; $\pi N(2060)$ confirmation with spin-parity $\frac{3}{2}^-$; and qualitative explanations for unusually large widths of N(1470), $\Sigma(1690)$, and $\Xi(1930)$. (L.B.S.)

25630 FINITE ENERGY SUM RULES FOR 10 + 10* AND 27 MESONS. Sakai, Sunao (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto), 40: 1389-97(Dec. 1968).

The existence of the 10 + 10* and 27 mesons are examined by studying the forward scattering of pseudoscalar-meson octet off baryon octet under the hypothesis of SU(3) symmetry, the Regge pole theory, and the j-plane analyticity. It is found that the numerical integrations of $\mathrm{Im}F^1_{10+10^*}(\nu)$ and $\mathrm{Im}F^1_{27}(\nu)$, which are controlled at high energy by Regge poles associated with the 10 + 10* and 27 mesons respectively, are zero within the experimental errors. For the parameters of the Regge poles associated with these mesons, it is found that one of the following three possibilities is realized. (1) $\alpha_{10+10^*}(0) < -1$ ($\alpha_{27}(0) < -2$) and $\beta_{10+10^*}(0)$ ($\beta_{27}(0)$) is not negligible, (2) $\beta_{10+10^*}(0)$ ($\beta_{27}(0)$) is small but $\alpha_{10+10^*}(0)$ ($\alpha_{27}(0)$) is not small, and (3) there are no Regge poles in the 10 + 10* and 27 states. (auth)

25631 BARYON COUPLING REGULARITIES. Hoff, R. B. (Univ. of Chicago). Phys. Rev. Lett., 22: 1021-2(May 12, 1969).

Possible empirical coupling regularities for baryons on Regge trajectories are indicated. (auth)

25632 CLASSIFICATION OF NUCLEON RESONANCES THROUGH PATTERN RECOGNITION. Otsuki, Shoichiro; Otsuki, Setsuko (Kyushu Univ., Fukuoka). Progr. Theor. Phys. (Kyoto), Suppl. Extra No., 196-210(1968).

With the expectation that a sizable difference of the "internal" structure of composite hadrons should phenomenologically display itself through a break of their "external" quantities, a search is made for such a possible break, that is meaningful from pattern recognition theory of information science, in six sorts of available external quantities of twenty-five nucleon resonances (mass, isospin, spin, parity, decay width and π-N partial width). If the break found in this way is regarded as directly corresponding to a classification of nucleon resonances, then in the best solution fifteen nucleon resonances belong to Class I (members of the N_α, N_γ and Δ_δ trajectories, N(1680, $\frac{5}{2}^-$) and N(1983, $\frac{7}{2}^+$) newly found through a recent π-N phase shift analysis, N(1550, $\frac{1}{2}^-$) and $\Delta(1640, \frac{1}{2}^-)$) while ten belong to Class II (the Roper resonance N(1470, $\frac{1}{2}^+$), etc.). A few physical remarks on the classification are given. (auth)

25633 A BOOTSTRAP MODEL OF THE BARYONS IN W_3 SYMMETRY. Schillaci, Mario Edward. Waltham, Mass., Brandeis Univ., 1968. 162p.

Thesis.

A bootstrap of the P(1/2) baryons and the ((3/2) baryon resonances is carried out within the framework of the W_3 symmetry scheme. The P(1/2) baryons are assigned to the nine dimensional irreducible representation of W_3 and the P(3/2) resonances are found to belong to the forty-five dimensional representation. Decomposing the W_3 representations of the SU_3 subgroup results in octet and singlet components for the P(1/2) nonet and 27-plet, decuplet and octet components for the P(3/2) 45-plet. The calculation is carried out using a multichannel N/D method in which the values of the $NN\pi$ and $N^*N\pi$ coupling constants must be assumed. The output values of the multiplet masses are found to be in fair agreement with the assumed input values. Symmetry breaking interactions are studied which lead to a parametrization of the masses of the SU_3 components of the W_3 multiplets. The splitting of the ninth baryon from the baryon octet is found to increase very rapidly as W_3 is broken while the mass of the 27-plet of resonances increases much less rapidly than that of the resonance octet. A second calculation is carried out in the static limit utilizing bootstrap equations derived from the Bethe–Salpeter equation. In this method, coupling constant ratios and the mass difference of the nonet and the 45-plet are determined self-consistently and are found to be in fair agreement with the results obtained using multichannel N/D method. Ratios of coupling constants involving π, N, and N* compare favorably with those found in the literature for the SU_2 and SU_3 cases. (Disser. Abstr.)

25634 CONSISTENT APPROACH TO CONTINUOUS MOMENT SUM RULES. Ferrari, E.; Violini, G. (Univ., Rome. Istituto Nazionale di Fisica Nucleare, Rome). Contract F 61052 67 COO84. Phys. Lett., 28B: 684-6(Mar. 17, 1969).

Continuous moment sum rules are rewritten in a form which is more suitable for their understanding and for a correct application. The results obtained are particularly significant in the cases where the real parts are not experimentally known. It is also shown that continuous moment sum rules are equivalent to a superposition of integer moment sum rules. (auth)

25635 DIP CANCELLATION BY AN INTERFERENCE PHENOMENON. James, P. B. (Univ. of Missouri–St. Louis, St. Louis). Phys. Rev., 179: 1559-60(Mar. 25, 1969).

Exchange-degenerate pairs of Regge trajectories are shown to interfere in such a way that the wrong-signature nonsense zeros, which often lead to dips, are cancelled. The particular example of backward K^+p scattering is discussed. It is shown to be plausible that the Λ_α and Λ_γ trajectories in this reaction are degenerate. Thus, the dips expected when $\alpha(\Lambda_\alpha) = -\frac{1}{2}$ and $\alpha(\Lambda_\gamma) = -\frac{3}{2}$ may be cancelled by this mechanism. (auth)

25636 EXCHANGE-DEGENERATE Λ-TRAJECTORY INTERPRETATION OF K^+p BACKWARD ELASTIC SCATTERING DATA. Barger, V. (Univ. of Wisconsin, Madison). Contract AT(11-1)-881. Phys. Rev., 179: 1371-3(Mar. 25, 1969). (COO-881-206).

A baryon Regge exchange model for K^+p backward elastic scattering is constructed in accordance with the requirements of duality and the absence of Y = +2 baryons. The dominant exchange-degenerate amplitude is associated with the $\Lambda_\alpha(1115, \frac{1}{2}^+)$ and $\Lambda_\gamma(1520, \frac{3}{2}^-)$ particles. Recent data on $d\sigma/du$ (K^+p) from 2 to 7 GeV/c are successfully reproduced. (auth)

25637 OLD–NEW MODEL FOR THE NUCLEON RESONANCES. Brudnoy, David M. (Rutgers–The State Univ., New Brunswick, N. J.). Phys. Rev., 179: 1388-1404(Mar. 25, 1969).

A simple phenomenological model of nucleon resonances is presented in which a resonance state is assumed to be a bound state of a point pseudoscalar particle and a point spin-$\frac{1}{2}$ particle. Associated with each resonant state is a nonlocal field operator which obeys generalized "Schrödinger" equations of motion. Assuming a relativistic harmonic-oscillator approximation for the "potential," a mass-spin relationship for members of a Regge trajectory can be derived, i.e., $m_R^2 = a + bj$ (the Regge formalism, however, is not employed here). Using the field operators in a phenomenological (Lorentz-invariant) Lagrange function, the decays of members of a Regge trajectory into a pion and a nucleon are calculated in a systemic way, with no more than two unknown parameters per trajectory to be determined from experiment (usually only one is needed). The resulting expressions for the partial decay widths are not an unreasonable approximation to experiment. One interesting feature of this model is the Gaussian-like form factors that appear in the partial decay widths. These form factors are a consequence of the nonlocal interaction assumed here; they appear naturally and are not introduced ad hoc. Another interesting feature—and, at the same time, a check on the calculations—is the fact that a good approximation to the πNN coupling constant can be derived, given the experimental partial decay width $\Gamma[N^*_{\frac{5}{2}}(1688) \to \pi N]$. The number obtained is $g^2_{\pi NN}/4\pi = 14.2$. (auth)

25638 O(3,1) SYMMETRY AND CONSPIRACY IN THE REACTION $\pi + N \to \rho + \Delta$ AT HIGH ENERGY. George, David J.; Nath, L. M. (Purdue Univ., Lafayette, Ind.). Phys. Rev., 179: 1382-8(Mar. 25, 1969).

The high-energy behavior of the differential cross section along the forward direction and the conspiracy relations in the reaction $\pi + N \to \rho + \Delta$ are discussed under the assumption of O(3,1) symmetry. It is found, as in the process $\pi + N \to \rho + N$, that transversely polarized mesons are produced predominantly by M = 1 Toller poles, while longitudinally polarized ones are produced by M = 0 Toller poles. However, in this case there are two possible values for the set of quantum numbers (j,j') for M = 1, and it is not clear whether both sets can be identified with the same pole. Furthermore, as we have no nucleon-antinucleon vertex in this reaction, no restrictions are placed on the signature of the Toller pole, and both odd and even signatures are possible. We are then faced with the very unusual possibility of class-III odd and class-II even conspiracies in addition to class-III even and class-II odd conspiracies. As in previous papers, the Toller poles are decomposed into families of Regge poles and the con-

spiracy relations consistent with analyticity are deduced. Finally, the formalism developed can be used to study the class of reactions a + b → c + d, where the particles c and d are different from the particles a and b, respectively. (auth)

25639 REGGE-POLE EIKONAL THEORY OF SMALL-ANGLE KAON–NUCLEON SCATTERING. Blackmon, Maurice L.; Goldstein, Gary R. (Argonne National Lab., Ill.). Phys. Rev., 179: 1480-5(Mar. 25, 1969).

A quantitative model for small-angle, high-energy kaon-nucleon scattering is presented. The model is a generalization of an eikonal Regge model of Arnold and Blackmon. Improvements on pure Regge models are naturally obtained. A natural crossover effect is found in $K^{\pm}$-p scattering and polarizations are predicted in K–N charge-exchange processes. Two pairs of exchange-degenerate Regge poles (the ρ and A_2 and the ω and P') and a flat Pomeranchon with a residue function given by a product of dipoles are used. All differential and total cross sections are fitted quite well. (auth)

25640 MODEL FOR LOW-ENERGY MESON–BARYON SCATTERING. Goldstein, Gary R. (Univ. of Chicago). Phys. Rev., 179: 1457-79(Mar. 25, 1969).

An effective Lagrangian, containing relativistic SU(6)-invariant three- and four-point interaction terms, is constructed for the scattering of the 35 meson representation by the 56 baryons. The lowest-order matrix elements calculated from the Lagrangian include single-particle exchange terms that account for long-range forces, and four-point interaction terms that approximate short-range forces for low-energy scattering. Because of the imposition of free-field conditions on the scattered particles, the amplitudes maintain a coplanar U(3) ⊗ U(3) symmetry, which is then broken by the mass differences in the multiplets. There are three parameters in the model, which are fixed by the S_{11}, S_{31}, and P_{11} scattering lengths for πN elastic scattering. Unitarity is implemented without introducing more parameters, by equating the matrix elements to those of the reaction matrix K. The amplitudes for all other reactions contained in 35 ⊗ 56 scattering are determined thereby. In particular, the cross sections and angular distributions for $\pi N \to \pi N$, $KN \to KN$, $\pi N \to \eta N$, $\pi N \to K\Lambda$, $\pi N \to K\Sigma$, and $\bar{K}N \to \eta\Lambda$ are calculated near their thresholds and compared with experiment. In all cases where comparisons can be made, the model is in fairly good agreement with the data, with the exception of $\pi N \to K\Sigma$. The threshold amplitudes for vector-meson production are also given as a prediction of the model. (auth)

25641 MASS-SHELL EVALUATION OF THE AMPLITUDE, PARTIAL CONSERVATION OF AXIAL-VECTOR CURRENT, AND EQUAL-TIME COMMUTATORS IN LOW-ENERGY $K^{\pm}p$ SCATTERING. Golestaneh, A. A. (Mount Union Coll., Alliance, Ohio); Gautam, V. P. Phys. Rev., 179: 1449-56(Mar. 25, 1969).

For the on-mass-shell calculation of the scattering amplitude, the following method was used. On the basis of the hypothesis of partially conserved axial-vector current (PCAC), the axial vector current $J = A + c\partial\phi$ is introduced where A is the current appearing in the PCAC relation, and ϕ is the pion field. Using this current in the Lehmann-Symanzik-Zimmermann formalism, the amplitude is decomposed into two terms W^{00} and W^{0} due to the equal-time commutators (ETC) of the divergence of the current J, respectively; a term W^{1} due to an ETC leading to a vector current; and a term W giving contributions of the discrete intermediate states. The ETC's of the current octet J are assumed to be similar in form, though not equivalent, to those normally used for the current A. For kaon-proton ($K^{\pm}p$) scattering, this formula was used in conjunction with dispersion relations and the SU(3) ⊗ SU(3) scheme, and sum rules for W^{0} and W^{1} were derived. Using the scattering length, the sum $W^{00} + W^{0}$ is evaluated. It is found that in order to obtain the correct signs and magnitudes of the $K^{\pm}p$ scattering lengths, with a single coefficient c in the PCAC relation, the sum $W^{00} + W^{0}$ must be taken into account, which seemed to be negligible in πN scattering. The difference between the on- and off-mass-shell amplitudes is derived, and seen to depend on the type of particles involved. Assuming that only the sum $W^{00} + W^{0}$ is a smooth function of the squares of the kaon four-momenta, this difference is found to be negligible in the $K^{-}p$ case, while it is 40% of the $K^{+}p$ scattering amplitude at threshold. (auth)

25642 MOMENTUM DEPENDENCE OF DIFFRACTION SLOPES IN MESON–NUCLEON SCATTERING. Lasinski, T. (Univ. of Chicago); Levi Setti, R.; Predazzi, E. Phys. Rev., 179: 1426-35(Mar. 25, 1969).

The slopes B(k) of the exponential forward peak for $\pi^{\pm}p$ and $K^{\pm}p$ elastic scattering were surveyed in the region $0.3 \lesssim P_{lab} \lesssim 20.0$ GeV/c. Plots of the momentum dependence of B(k) reveal striking enhancements at momenta corresponding to the location of known high-spin, high-elasticity resonances. There are indications that the background behavior of B(k), when considered over such a wide momentum interval, might be smoothly rising in all cases; thus, the forward peak associated with background diffraction effects would appear to shrink not only in $K^{+}p \to K^{+}p$ interactions, where resonance formation is weak (or absent), but also in $\pi^{\pm}p \to \pi^{\pm}p$ and $K^{-}p \to K^{-}p$ interactions, where many prominent resonant states are formed. An explanation for the behavior of B(k) is presented, based on the properties of the logarithmic derivative of the differential cross section in the forward direction. As a quantitative illustration, $B(k)_{K^-}$ was derived in terms of a simple phenomenological model, which involves a linear superposition of diffractive-like and resonant amplitudes. In this way a fit to the $B(k)_{K^-}$ and $K^{-}p$ total-cross-section data could be obtained throughout the entire momentum region. The information which can be derived from the experimental study of B(k) is discussed; this has bearing on the determination of resonance properties and on the behavior of the spin-flip amplitude. (auth)

25643 EFFECT OF WEAK MAGNETISM IN THE SEMI-LEPTONIC DECAY OF HYPERONS. Desai, P. S. (Univ. of Maryland, College Park). Phys. Rev., 179: 1327-9(Mar. 25, 1969).

For the baryon semileptonic decay $B \to B' + e + \bar{\nu}$, the correlation function among the spin of the final baryon and the momenta of the leptons is computed, assuming only first-class hadronic weak currents. The weak-magnetism term is found to enter the correlation function in the first order in $(m_B - m_{B'})/m_B$ via interference with the vector and the axial-vector terms. The expression may be useful in the future experimental determination of the magnetic form factor for various hadronic weak currents. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 25555.

25644 (LNF–68/74) LARGE ANGLE p–p SCATTERING, CERULUS–MARTIN BOUND AND THE VENEZIANO MODEL. Cassandro, M. (Istituto Nazionale di Fisica Nucleare, Rome (Italy). Rome Univ. (Italy). Istituto di Fisica); Greco, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Dec. 13, 1968. 14p. Dep.

The Veneziano model, modified in order to satisfy the Cerulus–Martin bound, is shown to give a very good description of p-p elastic scattering over the full range of t, but the diffraction peak. (auth)

25645 (ORNL-tr-2130) COMPUTING PROCESS FOR INTRANUCLEAR CASCADES. Barashenkov, V. S.; Gudima, K. K.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). Translated for Oak Ridge National Lab., Tenn., from report JINR–P2-4065. 14p. Dep. CFSTI.

A detailed description of a scheme for calculating intranuclear cascades by means of the Monte Carlo method is given. This proposed computing scheme is applicable only to accelerating energies not exceeding several 10 GeV. The scheme was tested on a large number of different cases and found to be very effective even when using relatively small computers. The nucleus is viewed as a Fermi gas of nucleons enclosed in the nuclear space. (J.F.P.)

25646 OSCILLATIONS OF HIGH ENERGY ELASTIC pp-SCATTERING CROSS SECTION AS FUNCTIONS OF MOMENTUM TRANSFER. Ansel'm, A. A.; Dyatlov, I. T. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 9: 416-23(Feb. 1969). (In Russian).

Qualitative speculations are presented which explain the appearance of momentum transfer oscillations of the elastic pp-scattering cross sections at high energies, predicted on the basis of the complex momenta theory. The same problem is discussed from the standpoint of analogy with the scattering on smooth potential which is due to the Pomeranchuk pole exchange. The theory is compared with previously observed oscillations of cross section in the elastic pp scattering. (auth)

25647 SIMPLE NUCLEAR SYSTEMS AND NUCLEAR INTERACTION. Slaus, Ivo (Inst. Rudjer Boskovic, Zagreb. Univ. of California, Los Angeles). pp 83-152 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 1. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.1).

The discussion of nuclear systems and the nuclear interaction covers nucleon–nucleon bremsstrahlung, nuclear reactions with multiparticle exit channels, and the neutron–neutron interaction with the validity of charge independence and charge symmetry. (J.F.P.)

25648 NUCLEON–NUCLEON INTERACTION. Noyes, H. P. (Stanford Linear Accelerator Center, Calif.). pp 9-82 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 1. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.1).

The solid progress which has resulted in an understanding of the nuclear force is shown. Emphasis is placed on physical ideas, rather than on the presentation of a comprehensive review. Nucleon–nucleon scattering at low energy, the structure of the nucleon–nucleon interaction revealed by scattering experiments at intermediate energies, and the three-nucleon problem are considered. (J.F.P.)

25649 TWO- AND THREE-BODY MODEL OF Λ-^{6}He. Barsella, Bruno; Lovitch, Lionel; Rosati, Sergio (Univ., Pisa, Italy. Istituto Nazionale di Fisica Nucleare, Pisa, Italy). 591-604 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2 Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

The binding energy of the hypernucleus Λ-^{6}He was calculated using two- and three-body models. Hard-core $\Lambda-N$ potentials were used in the three-body calculation. (J.W.R.)

25650 ON HIGH-ENERGY SCATTERING FROM DEUTERONS FROM FADDEEV'S THREE-BODY FORMALISM. Bhasin, V. S. (International Centre for Theoretical Physics, Trieste, Italy). pp 751-7 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

Starting from Faddeev's three-particle formulation it is determined how far the single and double scattering terms in the general approach can be reduced to the Glauber form. The essential conclusion seems to be that from the off-shell amplitude, which is required to be a function of momentum transfer only, one would obtain the Glauber formula in the high-energy low-momentum transfer region. (J.F.P.)

25651 FINAL STATE INTERACTION IN THE DECAY OF HYPERNUCLEI WITH $A \leq 5$. Juric, M.; Adamovic, O. (Inst. of Physics, Belgrade). pp 661-7 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

The momentum distribution of mesons (π^-), that could be determined from the final state configuration of decay products of hypernuclei, was determined from previous data. Also the angular distribution of alpha particles as a cosine function of the angle between the direction of the alpha particle and direction of emission of the meson (π^-) in the π^-–p rest system was investigated. The angles in the laboratory system between protons and alpha particles with a direction opposite to that of the meson (π^-) momentum were also determined. (J.F.P.)

25652 NEUTRON PRODUCTION IN LEAD AND ENERGY RESPONSE OF A NEUTRON MONITOR. Shen, Ming-liang (Franklin Inst., Swarthmore, Pa.). Nuovo Cim., Suppl., 6: 1177-1224(1968).

The dependence of the mean neutron multiplicity in a relevant nucleon–nucleus collision is discussed on the basis of the intra nuclear cascade model in the low-energy region below 10 GeV and in the high-energy region above 15 GeV. The mean multiplicity is estimated from emulsion data. Some comments are made on previous work which stimulated attempts to extend the use of the neutron monitor. (J.F.P.)

25653 HIGH-ENERGY pp LARGE-ANGLE SCATTERING. Andreev, I. V. (Lebedev Inst. of Physics, Moscow); Dremin, I. M.; Gramenitskii, I. M. Nucl. Phys., B10: 137-44(1969).

It is shown that a previously derived angular dependence of the differential cross sections of large-angle elastic scattering fits very well with experimental data on pp-scattering at momenta 8.1, 9.2, 10.1, 11.1, and 12.1 GeV/c. Results of a least-square test are given. A shoulder in the pp differential cross section at $1.2 \lesssim p^0 \lesssim 1.4$ GeV · rad/c is predicted at these energies. It connects the diffraction cone with the intermediate-angle region. The existence of this shoulder is supported by recent experimental data at 19.2 and 21.1 GeV/c. Very large angles (near $\frac{1}{2}\pi$) are also discussed. The general variation of pp differential cross sections as functions of both angle and momentum is drawn. (auth)

25654 EFFECTS OF THE FORM FACTORS IN THE ONE-BOSON-EXCHANGE MODEL OF NUCLEON–NUCLEON SCATTERING. Kikugawa, Masayoshi (Hiroshima Univ.); Watari, Wataro; Yonezawa, Minoru. Progr. Theor. Phys. (Kyoto), Suppl. Extra No., 170-8(1968).

It is shown that the introduction of the form factors in the one-boson-exchange model of nucleon-nucleon scattering in terms of the K-matrix method does considerably improve the fit to the experimental data. Strong momentum dependence is suggested for the vector-meson form factors. (auth)

25655 HIGH-ENERGY LARGE-ANGLE PROTON–PROTON SCATTERING. Wilcox, Roland Eugene. Columbia, Mo., Univ. of Missouri, 1968. 74p.

Thesis.

A study was made of elastic proton-proton scattering at high energy and large momentum transfer using an extension of a model first proposed by K. Huang which decomposes a proton during collision in an incoherent combinatorial manner. The technique used is slightly different but equivalent to the method used by Huang in obtaining the final probabilities for the final states. The new procedure allows one to keep N or the energy to finite, but large values. The analysis is limited to spinless protons and to regions of high energy where there exists no discontinuity in the shape of the angular distribution as was discovered previously around 8 to 11 BeV/c in the laboratory system. The results of the theoretical curves are in excellent agreement with the experimental results from the center of momentum angles of 65 to 90° and laboratory momenta of 14 to 27 BeV/c. The quenching of large momentum transfers for final states which is observed experimentally is duplicated. (Disser. Abstr.)

25656 HIGH-ENERGY NUCLEON SCATTERING AND ELECTROMAGNETIC FORM FACTORS. Fried, H. M. (Brown Univ., Providence); Gaisser, T. K. Contract AT(30-1)-2098. Phys. Rev., 179: 1491-8(Mar. 25, 1969). (NYO-2262TA-194).

A field-theoretic model of the exchange of virtual soft neutral vector mesons between nucleons is shown to provide the needed damping to describe pp elastic scattering and the electromagnetic form factors of the proton at high energies and large momentum transfers. The model permits a calculation of the infinite-energy limit of pp scattering, and suggests that $p\bar{p}$ scattering will rise to that limit at very high energies. (auth)

25657 PION PRODUCTION IN NUCLEON–NUCLEON COLLISIONS AT THRESHOLD. Schillaci, M. E.; Silbar, R. R.; Young, J. E. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 179: 1539-45(Mar. 25, 1969).

A theory of soft-pion production by nucleons is presented which provides a connection between the production amplitude and nucleon-nucleon scattering. This is done by applying the algebra of currents to the S-matrix element for the process $\gamma + 2n \rightarrow 2N + \pi$. After reducing out both the photon and pion, the hypothesis of partially conserved axial-vector current is used to replace the pion field by the divergence of the axial-vector current. Using the current commutation relations, the pion production amplitude is then obtained in terms of the amplitude for photoproduction of a pion on two nucleons, plus a correction integral which vanishes in the soft-pion limit. Upon taking the soft-photon–soft-pion limit, only certain pole terms survive. In this way, pion production is directly related to off-shell nucleon-nucleon scattering. Results are presented for the reactions $pp \rightarrow np\pi^+$, $np \rightarrow pp\pi^-$, and $pp \rightarrow pp\pi^0$. The theoretical predictions are found to be in good agreement with the cross-section data near threshold for π^- and π^0 production, and with an extrapolation from higher-energy data for π^+ production. (auth)

25658 KAON PRODUCTION IN p–p COLLISIONS AT THRESHOLD. Schillaci, M. E.; Silbar, R. R.; Young, J. E. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 179: 1546-7(Mar. 25, 1969).

Using a soft-kaon approximation, predictions are made of the total cross section for the process $pp \rightarrow p\Lambda K^+$ near threshold. A typical result is $\sigma_{tot} \approx 1.5$ μb at $P_{lab} = 2.40$ GeV/c. (auth)

25659 REGGEIZED DOUBLE-PERIPHERAL-MODEL ANALYSIS OF THREE-BODY FINAL-STATE PROCESSES: APPLICATION TO $pp \rightarrow p\pi^-\Delta^{++}$ AT 28.5 GeV/c AND OTHER REACTIONS. Berger, Edmond L. (Univ. of California, Berkeley. Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 179: 1567-79(Mar. 25, 1969).

Use of a double-Regge-pole-exchange model to describe peripheral three-body final-state processes, especially at near-threshold values of the invariant mass of a pair of final-state particles, is described and discussed. The fact is stressed that the model provides an understanding of the entire reaction, yielding distributions in all kinematical variables. As an example, results are presented from a detailed comparison of the predicted model distributions with data from $pp \rightarrow p\pi^-\Delta^{++}$ at 28.5 GeV/c. One simple diagram involving only Pomeranchon and pion exchanges is employed. Good agreement is obtained with the experimental distributions in invariant masses, momentum transfers, and various angles; in

particular, the enhancement near 1460 MeV in the ($\pi^-\Delta^{++}$) mass spectrum is well fitted. Recent applications of the model to the A_1 region in $\pi N \to \pi\rho N$ are reviewed. Also explored is the potential for extracting information on the pion trajectory from three-particle final-state reaction data. (auth)

25660 SIGNATURE OF REGGE CUTS COUPLED TO SPINNING PARTICLES. Branson, David (Univ. of Essex, Eng.). Phys. Rev., 179: 1608-16(Mar. 25, 1969).

It is proved, by perturbation theory and by the method of Sudakov, that if two Regge poles with trajectories α_1, α_2 and signatures τ_1, τ_2 are exchanged, the resulting Regge branch point at $j = \alpha_1 + \alpha_2 - 1$ appears only in partial-wave amplitudes of signature $\tau_1\tau_2\eta$, where $\eta = -1$ if both Regge poles are fermions and $\eta = +1$ otherwise. An example is given from the case of proton-proton scattering. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 25579 and 25699.

25661 (CERN-69-7, pp 291-305) REVIEW OF THE EXPERIMENTAL SITUATION RELEVANT TO CP VIOLATION. Steinberger, J. (European Organization for Nuclear Research, Geneva (Switzerland)).

The modification of theories of elementary particle interactions to account for CP violating effects is considered. A review is given of those experimental results which seem most relevant to the solution of this problem. This review covers CPT conservation in strong or electromagnetic interactions, C or T violation in strong or electromagnetic interactions, CPT invariance in weak interactions, T invariance in weak interactions, and CP violation in K decay. (J.F.P.)

25662 CANONICAL METHOD FOR CALCULATIONS OF EFFECTS FOR PARTICLES WITH ARBITRARY SPIN. Lizin, I. M.; Shelepin, L. A. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 9: 440-50(Feb. 1969). (In Russian).

A new method to calculate cross sections for particles with arbitrary spin is proposed. The method is based on the group-theoretical analysis for finite-dimension relativistic free equations $a^{\mu}\partial_{\mu}\psi + \varkappa\psi = 0$. Commutation relations for the matrix a^{μ} are not used at all, that provides the universality on the spin of particles. Cross sections are described by corresponding Feynman graph practically immediately in a compact explicitly relativistic-invariant (canonic) form. The transition to the conventional form of description of the cross section is also given. The method is convenient to investigate symmetries and to analyze higher orders of the perturbation theory. (auth)

25663 CLOSED EXPRESSIONS FOR THE ENERGY LEVELS IN BROKEN SYMMETRIES AND THE GENERAL FORM FOR REGGE DAUGHTER TRAJECTORIES. Kuo, P. K.; Suranyi, P. (Johns Hopkins Univ., Baltimore). Phys. Rev. Lett., 22: 1025-7(May 12, 1969).

A new method is proposed which summarizes in closed compact form all the implications of analyticity in a problem with broken symmetry. This method is applied to the Bethe-Salpeter equation to obtain the broken-SL(2,C) results for the Regge daughter trajectories in a closed functional form: $\alpha_k^{(s)} + k = F(t, t(\alpha_k^{(s)} + \tfrac{1}{2})^2, \pm E^{2M}(\alpha_k^{(s)} + M)(\alpha_k^{(s)} + M - 1) \ldots (\alpha_k^{(s)} - M + 1))$, where F is an analytic function in three variables. (auth)

25664 FINITE- AND INFINITE-COMPONENT WAVE EQUATIONS. Gyuk, I.; Umezawa, H. (Univ. of Wisconsin, Milwaukee). Phys. Rev. Lett., 22: 972-4(May 5, 1969).

It is shown that there exists a strong reciprocal relationship between the algebras associated with the wave equations of Bhabha and Nambu. The representations of the two groups obtained, O(6) and O(4,2), respectively, are the simplest algebras which can describe supermultiplets relativistic particles. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstract 25618.

25665 (CERN-69-7, pp 307-8) DISCUSSION REMARK ON T AND PCT. Kabir, P. K. (Rutherford High Energy Lab., Chilton (England)).

The breakdown of T and CPT invariance is considered. It is stated that once η_+ and η_{00} are known, the breakdown of T and CPT invariance is directly demonstrable. (J.F.P.)

25666 (CERN-69-7, pp 309-27) A MEASUREMENT OF THE PHASE AND THE MODULUS OF η_{00}. Chollet, J.; Gaillard, J-M.; Jane, M. R.; Ratcliffe, T. J.; Repellin, J-P.; Schubert, K. R.; Wolff, B. (European Organization for Nuclear Research, Geneva (Switzerland)).

The phase of η_{00} was determined in order to resolve the ambiguity between the two solutions of the Wu and Yang triangle. The data were analyzed in order to obtain the quantity $|\eta_{00}|$ also. The value of the latter quantity was found to be $(3.2 \pm 0.7)10^{-3}$. (J.F.P.)

25667 (CERN-69-7, pp 343-8) ELECTRIC DIPOLE MOMENT OF SPINOR PARTICLES AND ELECTROMAGNETIC CP-VIOLATION. Filippov, A. T.; Oziewicz, Z.; Pikulski, A. (Joint Inst. for Nuclear Research, Dubna (USSR)).

The simplest estimations of the electric dipole moment of spinor particles are considered assuming that the electromagnetic violation is due to the off-mass-shell corrections to the electromagnetic vertices. It is demonstrated that an electromagnetic CP violation may exist which does not contradict present experimental evidence on the electric dipole moment quite independently of special assumptions on the S = 0, P = -1, and CP = +1 nonleptonic weak interaction and which may cause rather large effects in electromagnetic processes where the off-mass-shell effects are essential. (J.F.P.)

25668 (CERN-69-7, pp 465-83) CHIRAL SYMMETRY BREAKING, ELECTROMAGNETISM, AND CABIBBO ANGLE. Gatto, R. (Padua Univ. (Italy). Istituto di Fisica).

The problem of the divergences in weak interactions is reviewed. Also the self-mass theorem and the vertex theorem, which together ensure the renormalizability of the theory in terms of two counter terms, are considered. The predictivity requirement, spontaneously broken SU(2) × SU(2), leading divergences, second order calculation in terms of current commutations, leading divergences at higher order in the quark model, and the self-mass theorem and the vertex theorem for the leading divergences are covered. (J.F.P.)

25669 NOTE ON THE SHAPE OF THE WEAK INTERACTION LAGRANGIAN. Shabalin, E. P. (Inst. for Theoretical and Experimental Physics, Moscow). Nucl. Phys., B10: 40-2(1969).

Some possible shapes of the weak interaction Lagrangian with CP violation are considered. It is shown that the Lagrangian with the imaginary constant of the interaction previously proposed by Wolfenstein to explain the CP noninvariance, results effectively in the same consequences as superweak interaction. (auth)

25670 TWO PHENOMENOLOGICAL ANGLES FOR SU(3) SYMMETRY BREAKING. I. WEAK AND ELECTROMAGNETIC INTERACTIONS. Konno, Kimiaki (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 40: 1424-38(Dec. 1968).

In order to treat the weak and the electromagnetic processes in a unified way, an empirical rule for SU(3) symmetry breaking is proposed by introducing two angles. It is shown in the weak interaction that semileptonic decays of mesons can be well explained once an angle is introduced. In particular a ratio $\Gamma(K^+ \to \pi^0 e^+ \nu_e)/\Gamma(K_L^0 \to \pi^+ e^- \bar{\nu}_e)$ is in remarkable agreement with experiment. The theory also leads to a prediction different from that of Cabibbo's theory concerning the decay processes $K_L^0 \to K^+ e^- \bar{\nu}_e$ and $\eta \to \pi^+ e^- \bar{\nu}_e$. In the electromagnetic interaction it is shown that high energy photoproduction of vector and pseudoscalar mesons and leptonic pair decay of vector mesons are also explicable with this model. From the analysis the tangent of these angles can be numerically fitted to the ratios of meson masses; that is, $\tan\theta = m_\pi/m_K$ for the weak interaction and $\tan\theta = m_\rho/m_\omega$ for the electromagnetic interaction. (auth)

25671 A PHENOMENOLOGICAL STUDY OF VIOLATION OF PC INVARIANCE IN DECAYS OF K^0 AND $\bar{K}^0$. Tsai, S. Y. (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 40: 1414-23(Dec. 1968).

A phenomenological study of violation of PC invariance in the $K^0-\bar{K}^0$ decays is given in the framework of PCT invariance. Relevant formulas are derived without recourse to a specific phase convention. The results of an analysis of the presently available experimental data suggest a possibility of a fairly large violation of the $\Delta S = \Delta Q$ rule and of PC invariance in the leptonic decay mode of the $K^0-\bar{K}^0$ system. (auth)

25672 NONLEPTONIC DECAYS OF K MESONS IN CHIRAL DYNAMICS AND THE PROOF OF THE $\Delta I = \frac{1}{2}$ RULE. Minamikawa, Toshiyuki (Tokyo Univ. of Mercantile Marine). Progr. Theor. Phys. (Kyoto), 40: 1402-13(Dec. 1968).

Weak interactions are constructed from the nonlinear chiral invariant Lagrangian, and the nonleptonic decays of K mesons are discussed in the chiral vector meson model. Correction to this model due to the current-current interaction and the K*-

and K_A-poles violates the $\Delta I = \frac{1}{2}$ rule, but the violation is quite small and consistent with experiment. Moreover it is assumed the intermediate boson mass to be 12 BeV in the model to explain the $K_1^0 \to 2\pi$ decay rate. (auth)

25673 CAN CP INVARIANCE BE SAVED? Kabir, P. K. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Rev. Lett., 22: 1018-20(May 12, 1969).

The experimental basis for the generally accepted statement that lingering 2π decays from a neutral kaon beam imply that CP invariance must be abandoned is examined. It is found that, apart from formulations which cannot be distinguished physically from theories admitting CP noninvariance, no CP-invariant description seems possible within the context of quantum theory. If quantum mechanics is disregarded, K^0-decay experiments do not necessarily contradict CP invariance. A crucial test is proposed for that case. (auth)

25674 CHARGE ASYMMETRY IN $K_{l3}^0 \to \pi^{\pm} l^{\mp} \nu$. Kenny, Brian G. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Rev., 179: 1617-19(Mar. 25, 1969).

It is noted that CPT invariance can be tested by comparing the charge asymmetry in $K_{l3}^0 \to \pi^{\pm} l^{\mp} \nu$ with certain terms in the time distribution of the decay $K^0 \to \pi l \nu$. It is pointed out that, under reasonable assumptions, the charge asymmetries for the electronic and muonic decay modes should be very nearly equal. Implications of a large discrepancy between the charge asymmetries are discussed. (auth)

25675 (JINR-P2-4367) STATISTICAL WEIGHT OF THE STATE WITH AN ARBITRARY NUMBER OF OCTETS AND DECUPLETS. Maltsev, V. M.; Remizov, G. N.; Smirnov, S. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 13p. (In Russian). Dep.

An integral expression for the statistical weight of the state, containing an arbitrary number of octets and decuplets, was obtained. (auth)

Applications (Strong)

Refer also to abstracts 25619, 25624, 25626, and 25629.

25676 (NEVIS-167) SEARCH FOR TIME REVERSAL INVARIANCE VIOLATION IN $\pi^- p \to n e^+ e^-$. Ross, William (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.). Jan. 1969. 87p. (CU-271; R-651).

Thesis.

An experiment performed at the Nevis Cyclotron looking for a violation of time reversal invariance in the reaction: $\pi^- p \to n e^+ e^-$ is described. Time reversal invariance requires the vanishing of the expectation value of $\vec{\sigma}_n \cdot (\vec{p}_+ \times \vec{p}_-) \cdot (E_+ - E_-)$. On the basis of 296 acceptable events, a raw asymmetry is measured proportional to this expectation value of -0.09 ± 0.09. If angular resolution factors and weight events are included by their theoretically expected contribution to the asymmetry, one obtains -0.11 ± 0.13. The measured asymmetry in $\vec{\sigma}_n \cdot (\vec{p}_+ \times \vec{p}_-)$, which is expected to vanish if charge conjugation invariance is valid for leptons, is -0.02 ± 0.10. (auth)

25677 AN INTRODUCTION TO LIE-ADMISSIBLE ALGEBRAS. Santilli, R. M. (Univ. of Miami, Coral Gables, Fla.). Contract AF AFOSR 1268-67. Nuovo Cim., Suppl., 6: 1225-49 (1968).

An elementary introduction to the theory of Lie-admissible algebras is given. Fundamental algebras, Lie-admissible algebras, Jordan-admissible algebras, and properties of Lie-admissible algebras are covered. (J.F.P.)

25678 SYMMETRY BREAKING OF CHIRAL SU(3) ⊗ SU(3) AND K–N SCATTERING LENGTHS. Kawarabayashi, Ken; Kitakado, Shinsaku (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 40: 1398-1401(Dec. 1968).

Within the framework of chiral dynamics, S-wave kaon–nucleon scattering lengths are calculated by taking into account the effect of symmetry breaking of chiral SU(3) ⊗ SU(3). The symmetry breaking term is assumed to transform like (3,3*) + (3*,3) under SU(3) ⊗ SU(3). The parameters are determined from the associated SU(3)-breaking mass term for the baryon octet. (auth)

25679 DISPERSION SUM RULES FOR THE BARYON SPECTRUM IN AN O(3,1) DYNAMICAL GROUP MODEL. Frampton, P. H.; Hamprecht, B. (Univ. of Chicago). Phys. Lett., 28B: 664-7(Mar. 17, 1969).

The saturation of superconvergence relations by the known N (isospin $\frac{1}{2}$) and Δ (isospin $\frac{3}{2}$) baryon resonances is studied. Two convenient sum rules occur in elastic π-Δ(1236) scattering. One sum rule has contributions only from N states, the other only from Δ states. For the pseudoscalar form factors an O(3,1) dynamical group model proposed by Barut and Kleinert is used. The well known Δ spectrum is consistent with the Δ sum rule. The known N resonances (for which the phase shift analyses are more ambiguous) are inadequate to saturate the N sum rule, and the nature of the missing contribution is briefly discussed. (auth)

25680 GENERAL THEORY OF CHIRAL TRANSFORMATIONS. Hiida, Kichiro; Ohnuki, Yoshio; Yamaguchi, Yoshio (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), Suppl. Extra No., 337-72(1968).

All types of chiral transformations for hadron fields are discussed in general. Local and nonlinear chiral transformations are investigated in detail for pseudoscalar mesons. Whereas linear and local chiral transformations (which are nonlinear for pseudoscalar mesons) are discussed for all other hadrons and shown to be "unique" provided the field variables are suitably redefined. General discussions are given on chiral invariant Lagrangian, equal-time commutators for currents, and conservation laws for currents in the presence of electromagnetic couplings, etc. (auth)

25681 CONSEQUENCES OF SU(3)'' EXCITATION IN BARYON RESONANCES. Greenberg, O. W.; Nelson, C. A. (Univ. of Maryland, College Park). Phys. Rev., 179: 1354-63(Mar. 25, 1969).

The SU(18) mass formula given earlier for the s^3-configuration baryons in the three-triplet model is derived. Selection rules for allowed decays of SU(3)''-excited baryon resonances are given using a new classification of mesons: among other selection rules, $N(1466) \to \Delta\pi(N\pi\pi)$, + $N\pi$; and $Z_1(1910) \to \Delta K(N\pi K)$, + NK, in the (no-mixing) approximation, where $C_2^{(3)}$ and $C_2^{(3)''}$ are good quantum numbers. The s^3, $J^P = \frac{1}{2}^+$ resonances such as N(1466) and N(1751) should be produced with even sharper forward peaking than the corresponding elastic process. The N(1466) resonance should not be electro- or photoproduced, in contrast to the N(1751) resonance, which should be produced electromagnetically. Experiments to detect exotic resonances are suggested. The present limits on backward K^-p elastic scattering are compatible with u-channel exchange of $Z_1(1910)$. A complete table of mass predictions for s^3-configuration baryon resonances is given. (auth)

25682 U(3) x U(3) CHIRAL SYMMETRY. Shiozaki, Takanori (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto), Suppl. Extra No., 44-68(1968).

A very simple method for constructing effective Lagrangian which is invariant under chiral U(3) × U(3) group is presented. The method is facilitated with the concept of chiral covariant. With this systematic approach interrelations of the various results which follow from the chiral symmetry alone and the results which require some additional assumptions are clarified. (auth)

Field Theories

Quantum Field Theory

25683 (CERN-69-7, pp 391-3) MASSIVE YANG–MILLS FIELDS. Veltman, M. (Paris Univ., Orsay (France). Faculte des Sciences. Utrecht Rijksuniversiteit (Netherlands). Instituut voor Theoretische Fysica).

Consideration is given to the importance of Yang–Mills fields in physics and also to perturbation theory of Yang–Mills fields. (J.F.P.)

25684 (CERN-69-7, pp 395-407) PARTIAL SYMMETRY, EQUIVALENCE THEOREMS AND CALCULATION OF HIGHER ORDERS IN NON-RENORMALIZABLE FIELD THEORIES. Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna (USSR)).

A discussion is given on the classification of field theories into renormalizable and nonrenormalizable ones, and a criterion for a more refined classification. The highly nontrivial nature of the localizability condition is emphasized; and a theorem about the localizability of certain equations is formulated. General methods are given for the treatment of nonrenormalizable theories. Integral equations for Green functions are found and solved. Some applications to theories with partial symmetry and to the derivation of the contribution of the scalar part of the Yang–Mills field are mentioned. (J.F.P.)

25685 (JINR-P2-4301) LAGRANGIAN FORMALISM FOR TENSOR FIELDS WITHOUT ADDITIONAL CONDITIONS. Zaikov, R. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 18p. (In Russian). Dep.

The Lagrangian formalism of tensor fields of any range without exception of the lower spins and with an arbitrary mass spectrum is considered. It is shown that the free field Lagrangian can be constructed from which follows positively definite energy. In this case the formalism is canonical. The interaction with the scalar

field is considered. An explicit form of the tensor field causal Green function is given. (auth)

25686 ASYMPTOTIC OF PLANE GRAPHS IN SPINOR THEORY. Ginzburg, I. F.; Efremov, A. V.; Serbo, V. G. (Inst. of Mathematics and Computer Center, Novosibirsk, USSR). Yadern. Fiz., 9: 451-7(Feb. 1969). (In Russian).

Simple methods to obtain the asymptotics of the plane graph from its topology are obtained. These methods are much more simple than those known from scalar theory. The asymptotics is determined only by the number of two-particle fissions in t-channel and by the number of divergent subgraphs. Such simplification is due to two limitations of the problem: (a) only renormalized mesonic theory with scalar or pseudoscalar coupling (1) is considered (b) only graphs with integer moment in t-channel (graphs with half integer moment in t-channel contribute fermionic Regge trajectories only) are studied. (auth)

25687 GENERALIZATION OF DYSON'S FORMULA. Seneor, Roland (Ecole Polytechnique, Paris). Commun. Math. Phys., 11: 233-56(1969).

An integral representation for tempered distributions which have more general support properties in x space, than those usually assumed in the derivation of the Dyson formula is given. The existence of such an integral representation is shown to be equivalent to that of a suitable extension of an analytic function: namely, given an analytic function on a section Ω of a domain of holomorphy Ω' extend it to Ω imposing on it some growth conditions. L^2 space methods of L. Hörmander are used to solve this problem of extension. In order to apply these Hilbert space techniques, it was necessary to prove two important theorems on the growth of analytic function. From the physical point of view the formula obtained is an integral representation for the commutator of two quasi local fields. (auth)

25688 PURE OPERATIONS AND MEASUREMENTS. Hellwig, K.-E.; Kraus, K. (Univ., Marburg, Ger.). Commun. Math. Phys., 11: 214-20(1969).

States of a quantum system may be influenced by an external intervention. Following Haag and Kastler, such a transformation of states is called an operation, and is called pure if it transforms pure states into pure states. Operations are discussed under the assumption that they are caused by interactions with another system (apparatus), described by an S matrix. Pure operations are then shown to correspond, with one exception, to operators A with norm smaller than one. The Hermitean operators $F = A^* A$ represent quantum effects as defined axiomatically by Ludwig. The particular case of local operations in quantum field theory is also investigated. (auth)

25689 TWO-DIMENSIONAL BETHE-SALPETER EQUATION FOR MASSIVE MESON EXCHANGE. Munakata, Yasuo; Aotsuka, Tsuyoshi (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), Suppl. Extra No., 259-68(1968).

The Bethe–Salpeter equation for massive meson exchange in two-dimensional space time is solved in the ladder approximation for $P_\mu = 0$, the special case of binding energy equal to the total mass. The solution is displayed in an integral representation in which the weight function is a series over λ, the coupling constant. The convergence of this series is guaranteed for any λ, and the eigenfunction and eigenvalue of the equation are given numerically by the use of computer. The properties and physical meanings of this solution are also discussed. (auth)

25690 QUANTUM ELECTRODYNAMICS IN NONLINEAR GAUGE. Nambu, Yoichiro (Univ. of Chicago). Progr. Theor. Phys. (Kyoto), Suppl. Extra No., 190-5(1968).

A simple mathematical formulation using the technique of nonlinear transformations is presented that allows quantum electrodynamics to be interpreted in terms of a spontaneous breakdown of Lorentz invariance. The formulation corresponds to fixing the gauge of the vector potential in a special manner. (L.B.S.)

25691 NONLOCAL FIELD THEORY IN TWO DIMENSIONAL SPACE–TIME. Katayama, Yasuhisa (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), Suppl. Extra No., 280-92(1968).

Nonlocal field theory is examined as the source of isospin freedom in terms of internal space-time structure of elementary particles. To focus our considerations to the dynamical isospin variables, the space-time is simplified to be two dimensional Minkowski space. Since the isospin depends on the total energy-momentum of each particle, the charge independence in the interacting system is assured only when some internal correlations exist among the interacting nonlocal fields. The system of complex bilocal field and real trilocal field interacting through Yukawa coupling is shown to be the assembly of local field with definite isospin interacting with each other by charge independent couplings, if the same internal correlation as the one which makes the independent quantization for each isoeigen local fields is assumed. (auth)

25692 A NEW METHOD FOR OBTAINING THE S OPERATOR IN PERTURBATION THEORY. Eoll, Christopher Kenneth. Toronto, Univ. of Toronto, 1967.

Thesis.

A formalism is set up for obtaining the perturbative S operator for an arbitrary field theory, "renormalizable" or "nonrenormalizable." The basic assumptions of the theory are Bogolyubov causality and TCP invariance of the S-operator. Interpolating fields are never used. In this formalism, calculations are based on a uniqueness theorem, rather than on an explicit prescription for the coefficients in the normal expansion of the S-operator. However there is manifest Lorentz covariance at each stage of the calculations. It is pointed out that there are not necessarily an infinite number of independent parameters needed to describe a "nonrenormalizable" theory in a perturbative treatment. Example calculations using the present formalism are carried out for the ϕ^3 theory, quantum electrodynamics and the Fermi interaction involving the muon, electron and neutrinos. (Disser. Abstr.)

25693 THEORY OF CURRENTS AND THE NONSTRONG INTERACTIONS. Gross, David J. (Harvard Univ., Cambridge, Mass.); Halpern, M. B. Phys. Rev., 179: 1436-44(Mar. 25, 1969).

General perturbations around Sugawara's theory of currents are considered. The usual forms for the semistrong, electromagnetic, and weak interactions are easily incorporated, and, using a modified interaction picture, a covariant Feynman-graphical approach to the perturbation is achieved. There is some degree of uniqueness in the allowed perturbation: If infinite polynomials are to be avoided in the theory, the perturbations must be of the form $V_\mu V^\mu$, or $V_\mu C^\mu$ (C^μ is a canonical vector field), or σ (the scalar density due to Bardakci, Frishman, and Halpern). (auth)

25694 EXISTENCE AND ANALYTICITY IN s OF THE SOLUTION TO NON-FREDHOLM BETHE–SALPETER EQUATIONS FOR SCATTERING OF SPIN-1/2 PARTICLES. Connell, John (Michigan State Univ., East Lansing). Contract AT(11-1)-1051. Phys. Rev., 179: 1374-81(Mar. 25, 1969).

A large class of non-Fredholm Bethe–Salpeter equations for the scattering Green's function of spin-$\frac{1}{2}$ particles is considered. Many commonly treated equations belong to this class; an example is the quantum-electrodynamical (QED) electron-positron Bethe–Salpeter (BS) equation in the ladder approximation. It is proven that a solution of these equations by successive iteration exists. A domain of analyticity of the solution in the s plane is derived. For small coupling constant, this domain is very large. The domain shrinks to the point $s = 0$ when the coupling constant is increased to a limiting value (of order unity). A simple and general inequality is derived for the binding energy of any bound state in terms of the coupling constant. It is proven that Goldstein's pseudoscalar homogeneous solution to the QED equation at $s = 0$ does not correspond to a bound state when the fine-structure constant is less than of order unity. The method of proof of the existence and analyticity is to use majorization to show that an infinite series of analytic functions is uniformly convergent. No Hilbert-space techniques are used, so no difficulties arise from the non-Fredholm nature of the BS equations. (auth)

Gravitation and General Relativity

25695 (AD–677344) RESEARCH IN THE APPLICATION OF SPINORS AND OTHER REPRESENTATIONS OF THE LORENTZ GROUP TO GENERAL RELATIVITY. Final Report, June 1, 1966–May 31, 1968. Cahen, Michel; Ozsvath, Istvan; Rindler, Wolfgang; Robinson, Ivor (Southwest Center for Advanced Studies, Dallas, Tex.). May 31, 1968. Contract N00014-67-A-0310. 16p. (SCAS–1484). CFSTI.

A wide class of exact solutions with rotating gravitational rays was obtained. A systematic account of exact solutions in vacuum in the presence of electromagnetic fields and in dust-like matter was largely completed. Locally isotropic spaces were studied. All three- and four-dimensional symmetric spaces were listed. Theorems about locally compact groups were established. It was proven that a global spin structure exists for a gravitational field if the second Stiefel–Whitney class of spacetime vanishes. The Lorentz group was investigated from the point of view of quaternions, bivectors and generalized cross-ratios. Work, focusing on solutions of the Boltzmann equation, was done developing a general-relativistic kinetic theory of gases. An analogy between the dynamics of the matter inside the Schwarzchild radius and the

dynamical situation in the parallel gravitational field corresponding to the uniformly accelerated frame was discovered. Two further exact solutions of Einstein's field equations were found, as well as all homogeneous solutions to the combined Einstein–Lichnerowicz field equations. The kinematics and the geometry of "the finite rotating universe" (Ozsvath–Schucking solution) were investigated. (auth) (USGRDR)

25696 UNSTABLE PARTICLES IN THE LEE MODEL. PROBLEM OF NONHERMITICITY OF THE HAMILTONIAN AND THE PROBLEM OF EIGENVECTORS. Chan, Vu Duy (Physique Mathematique, Paris). Compt. Rend., Ser. A, 268: 133-6(Jan. 13, 1969). (In French).

A study is made of the existence of a complex eigenvalue of the type z_0, ($z_0 = x_0 + iy_0$) of the eigenstate corresponding to z_0, and of the nonhermicity of the hamiltonian when z_0 exists. (J.F.P.)

25697 UNIFIED THEORY OF CONTINUOUS MATTER AND ACTION. Lipkin, D. M. Nuovo Cim., Suppl., 6: 1371-1410 (1968).

The framework of general relativity theory is used to give reasons for disregarding the Einstein equations; for interpreting all matter as a manifestation of a universal nonnull background electromagnetic field; for expecting continuous distributions of electricity to reside in regions of this field; and for recognizing a novel action functional on the metric and electromagnetic fields. Coupled differential equations are derived for these fields. This unified field theory is shown to be invariant in form under the interchange of the metric and energy tensors, and to be conformally invariant although it does not have a Weyl linear connection or gauge dependence. These invariances are discussed with reference to the quantum reciprocal relations, a novel relativistic phase space, and the quantization of action leading to the inference that the fundamental Planck quantum can be seen as a completely closed and periodic elemental model universe. (J.F.P.)

25698 MATTER AS CURVED SPACE-TIME. Gardner, J. W. New Sci., 42: 115-17(Apr. 17, 1969).

The idea of matter as curled-up space implies the existence of "antispace," analogous to antimatter. This concept leads naturally to quantization of the gravitational field, and offers a promising basis for a unified theory embracing nuclear and electromagnetic phenomena. (auth)

25699 STRUCTURE AND SOLUTIONS OF A UNIFIED THEORY OF GRAVITATION AND SYMMETRY VIOLATION. Moen, I. O.; Moffat, J. W. (Univ. of Toronto). Phys. Rev., 179: 1233-8(Mar. 25, 1969).

The structure of a unified theory of gravitation and symmetry violation of U(3) [or U(3) ⊗ U(3)] is studied, and exact solutions for the symmetry-breaking fields are obtained. These solutions are then investigated in the absence of gravitational fields by expanding the nonlinear symmetry-breaking equations in powers of a small parameter λ. It is shown that the resulting nonlinear equations can be solved, in association with the divergence equations for weak vector (or axial-vector) current densities, to determine by iteration the breaking to any order. It is found that the breaking to first order, determined by linear equations, is caused by zero-mass particles. In the case of SU(2), in the linear approximation, equations consistent with Maxwell's electrodynamics and the correct form of the divergence equation for the isotopic-spin current are obtained. (auth)

25700 PETROV CLASSIFICATION OF ORTHOGONAL METRIC SPACES. Marathe, K. B. (Univ. of Poona). Proc. Nat. Inst. Sci. India, Part A, 34: 301-12(Nov. 1968).

The Petrov classification has been used, following the matrix notation, to examine the general metric of the orthogonal type, referred to as Dingle's metric here. The algebraic conditions that have to be satisfied in transition from local anisotropy to local isotropy through the intermediate stages of the Penrose diagram have been obtained. The algebraic conditions are really differential equations, the solution of which presents a series of new problems. The equivalence of neighborhoods as considered here can be of considerable significance in the exploration of new gravitational fields. The conditions do not seem to have been studied before. They have been considered with reference to some special metrics of interest. (auth)

25701 GEOMETRODYNAMICS OF THE NULL FIELD. Iyengar, Vanaja (Osmania Univ., Hyderabad, India). Proc. Nat. Inst. Sci. India, Part A, 34: 313-19(Nov. 1968).

For a non-holonomic form of the matrix (h_{ij}), compatible with the real electromagnetic null field, the conditions of existence of two analytic functions ρ and σ satisfying the Einstein–Maxwell equations are investigated. (auth)

25702 PURE-RADIATION NEWS FUNCTION IN GENERAL RELATIVITY. Stachel, John (Boston Univ.). Phys. Rev., 179: 1251-2(Mar. 25, 1969).

The Bondi–Sachs analysis of empty-space gravitational fields is extended to include the presence of a pure-radiation stress-energy tensor, $T_{\mu\nu} = \sigma k_\mu k_\nu$. A pure-radiation news function is defined and shown to contribute to the change of the mass aspect in a way analogous to the gravitational news functions. It is suggested that this type of analysis may prove useful in the study of bodies simultaneously emitting high-frequency incoherent and low-frequency coherent gravitational radiation. (auth)

25703 PRODUCTION OF PARTICLES BY GRAVITATIONAL FIELDS. Sexl, Roman U.; Urbantke, Helmuth K. (Univ. of Georgia, Athens). Phys. Rev., 179: 1247-50(Mar. 25, 1969).

The production of particles by gravitational fields is calculated within the framework of quantum field theory. It turns out that the expansion of the universe—giving rise to a time-dependent gravitational field—does not lead to an appreciable production at present, since the frequencies involved are too low. Particle production was, however, of importance during the first 10^{-20} sec after a "big bang." This mechanism of particle creation leads to equal numbers of particles and antiparticles. (auth)

Scattering Theory

Refer also to abstract 25956.

25704 (CERN-69-7, pp 349-60) CURRENTS IN S-MATRIX THEORY. Mandelstam, Stanley (California Univ., Berkeley. Dept. of Physics).

The method of dispersion relations is extended to calculate weak amplitudes. Conserved currents in general, conserved axial currents with their associated Goldstone bosons, and the problem of the commutation relations between currents from the viewpoint of S-matrix theory are discussed. Conserved axial currents and axial-current commutation relations are considered. It is shown that the commutation relation between total charges, unlike the local commutation relations between current densities, are consequences of the Adler self-consistency condition. (J.F.P.)

25705 (JINR-P1-4281) RECTANGULAR DALITZ-PLOTS. Kopylov, G. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1969. 15p. (In Russian). Dep.

The two-dimensional diagrams of the state of several particles (like Dalitz-plot and triangle-plot) may be plotted as rectangle. (auth)

25706 (JINR-P2-4356) ON THE FUNCTIONAL RELATIONS BETWEEN THE MATRIX ELEMENTS OF THE ELASTIC SCATTERING STATIC S-MATRIX. Meshcheryakov, V. A.; Rerikh, K. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 11p. (In Russian). Dep.

An algorithm for finding the polynomial functional relations between the matrix elements of the s matrix in equations of the Chew–Low type is suggested. The algorithm is suitable in searching for the functional relations using a computer and is applied to finding the functional relations in equations with the 3×3 matrix A^{Ch-L}. (auth)

25707 SCHROEDINGER'S DIFFERENCE EQUATION FOR TWO RELATIVISTIC PARTICLES IN SIMPLEST CASES. Kadyshevskii, V. G.; Mir-Kasimov, R. M.; Skachkov, N. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 9: 462-71(Feb. 1969). (In Russian).

On basis of the Schroedinger relativistic difference equation the relativistic analogs are presented for the current, continuity equation and scattering phase shifts. Exact solutions are obtained for some problems with simple potentials. (auth)

25708 POMERANCHUK POLE AND SCATTERING AT NON-SUPERHIGH ENERGIES. Gribov, V. N. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 9: 424-31(Feb. 1969). (In Russian).

Effect of branch points which are due to the Pomeranchuk pole on the scattering amplitudes in the energy region of the order of some dozens of GeV's is considered. It is shown that the contribution from the cuts cannot be small (less than 10% in the nucleon-nucleon scattering) in this energy region. However, in the diffraction cone region the contribution from the cuts slightly differs from the pole contribution due to small slope of the pole trajectory as compared to the inverse width of the diffraction cone. (auth)

25709 RESCATTERING EFFECTS IN MULTIPARTICLE FINAL STATES. Aitchison, I. J. R. (Oxford Univ.). pp 607-31 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

Rescattering effects in three-particle final states are reviewed. A simple model for three-particle final state interactions, integral equations for final-state interactions, and other final states are discussed. (J.F.P.)

25710 BOUND-STATE SCATTERING IN THE LEE MODEL. Liu, Tsu-huei; Zimmerman, R. L. (Univ. of Oregon, Eugene). Nuovo Cim., Suppl., 6: 1297-1328(1968).

Tau functions in the $V-2\theta$ sector of the Lee model, which contains a bound state for sufficiently large values of the coupling constant, are solved. Also the bound-state scattering processes are studied. A nonperturbative expansion is developed in which for each term in the series, the properties of the $V-\theta$ bound state, the symmetries of the tau functions, and their analytic structure are preserved. (J.F.P.)

25711 INTRODUCTION TO A COMPLEX ANGULAR-MOMENTUM THEORY OF NUCLEAR-RESONANCE REACTIONS. Viano, G. A. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo Cim., Suppl., 6: 1277-96(1968).

The complex angular momentum theory of nuclear reactions covers pole expansions for the S-matrix and the Watson transform in the case of elastic scattering of spinless particles, the concept of pole-trajectory and the complications due to the Coulomb interaction. Also discussed are the many-channel problems in relation to the inelastic reactions and to the spin, the concept of signature, and phenomenological applications. (J.F.P.)

25712 UNITARITY IN THE $N\theta\theta$ SECTOR OF SOLUBLE MODEL WITH INDEFINITE METRIC. Lee, T. D. (CERN, Geneva); Wick, G. C. Nucl. Phys., B10: 1-10(1969).

Assuming that the $N\theta$ sector of a certain soluble model with an indefinite metric contains no stable V state, the unitarity condition of the S-matrix is explicitly verified in the $N\theta\theta$ sector. (auth)

25713 CROSSING EQUATIONS, KINEMATIC CONSTRAINTS, AND THE REGGE MODEL OF ELASTIC SCATTERING. Actor, Alfred Arthur Jr. Los Angeles, Univ. of California, 1968. 151p.

Thesis.

The Trueman-Wick crossing equations that connect any elastic scattering channel with its crossed channel are, by assuming parity and time reversal invariance in the elastic channel, decomposed into four much simpler closed systems of equations. To achieve this, new amplitudes are defined which are certain linear combinations of the helicity amplitudes. In terms of the new amplitudes, elastic channel forward scattering constraints are of two distinct types. These constraints, on crossed channel amplitudes, are expressed for arbitrary spins of the elastic channel particles. The crossed channel amplitudes are Reggeized. One type of constraint is seen to require conspiracies among Regge trajectories, while the other does not. Two versions of the Regge model of elastic scattering are constructed. These explicitly satisfy both types of constraints for any spins. One version evades all conspirator constraints. The other is the simplest possible conspirator model. (Disser. Abstr.)

25714 SIGNATURE IN PRODUCTION AMPLITUDES. Drummond, I. T.; Landshoff, P. V.; Zakrzewski, W. J. (Cambridge Univ., Eng.). Phys. Lett., 28B: 676-8(Mar. 17, 1969).

A general discussion of the effect of signature is given. The conclusions are that nonsense decoupling should not be expected to occur for α_1 equal to a wrong signature positive integer and that the effects of signature on the phase of the amplitude are not at all simple. Whereas for two-body scattering the phase of the amplitude at high energy may be calculated from that of the signature factor $\xi_\alpha = \exp(-i\pi\alpha) + \tau$, where τ is the signature, this is not the case for a production amplitude. The discussion applies equally to the incorporation of signature in three models: that of Veneziano applied to production amplitudes, that in which the two Reggeons are generated by ladders, and Gribov's hybrid perturbation theory model. The ladder model is studied. (J.F.P.)

Particle Accelerators

Refer also to abstracts 24174, 25558, and 25801.

25715 (AD-678100) AN INTERNALLY CALIBRATED ELECTRON SPECTROMETER FOR ACCELERATOR ENERGY MONITORING. Instrumentation Papers No. 147. Fritts, Martin J.; Lowe, Lester F.; Rombalski, William F.; Wall, James A. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Aug. 1968. 20p. (AFCRL-68-0408). CFSTI.

An internally calibrated electron spectrometer was developed for use in calibrating the AFCRL Dynamitron and Van de Graaff accelerators. The spectrometer utilizes a Bi207 source which emits internal conversion electrons of precisely known energies. The system can be attached to the accelerators easily and yields a resolution of better than 1 percent. (auth) (USGRDR)

25716 (AD-678717) RF AMPLITUDE AND PHASE STABILIZATION FOR A SUPERCONDUCTING LINEAR ACCELERATOR BY FEEDBACK STABILIZATION TECHNIQUES. Suelzle, Larry R. (Stanford Univ., Calif. High-Energy Physics Lab.). June 1968. Contract Nonr-225(67). 23p. (HEPL-564). CFSTI.

Some of the feedback stabilization techniques being examined and tested at Stanford are described, and how the high-Q characteristic of a superconducting linac can simplify some of the feedback control problems is discussed. (auth) (USGRDR)

25717 (AD-679172) REPORT OF CYCLOTRON OPERATION, JANUARY 1-JUNE 30, 1968. (Naval Research Lab., Washington, D. C.). Oct. 1968. 30p. (NRL-MR-1921). CFSTI.

The operation and use of the NRL Sector-Focused Cyclotron is described for the period 1 January-30 June 1968. During this period the major efforts were in facility start-up. These efforts included beam extraction, transport to experimental stations and initiation of the experimental program. The first extracted beam was obtained on 12 February 1968. On 11 March 1968, a beam was transported through the 9-ft. radius of curvature analyzing magnet. On 27 April 1968, a beam was transported into Experimental Room 2. During May, isotope production was initiated in the cyclotron vault, and preliminary measurements on the Doppler-shift Attenuation Experiment were started in Room 2. In June, preliminary scattering studies were begun in the 30 inch diameter scattering chamber in Room 3. (auth) (USGRDR)

25718 (AEC-tr-6718) THEORY OF LINEAR ACCELERATORS. Vlasov, A. D. Translated by Z. Lerman from Teoriya Lineinykh Uskoritelei, Atomizdat, Moscow, 1965. 256p. (TT-68-50322; IPST-Cat.-1824). CFSTI.

The characteristics of modern proton and electron linear accelerators are discussed, although emphasis is placed on the theory of proton linear accelerators. Topics associated with proton linear accelerators include longitudinal motion of particles, defocusing forces and focusing techniques, quadrupole focusing, alternating-gradient focusing, longitudinal focusing, as well as grid and foil focusing. A treatment of general theoretical topics associated with electron linear accelerators is presented. A discussion of tolerances and high-current acceleration of electrons is also included. An extensive bibliography on the theory of linear accelerators is given. (B.G.D.)

25719 (AECL-3193) NUMERICAL CALCULATIONS ON BEAM MATCHING. Bezic, N.; Lee-Whiting, G. E. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Nov. 1968. 51p. (FSD/ING-145). Dep. CFSTI. CAN $1.50.

Results are given for a miscellany of numerical calculations carried out with the matching equations derived earlier. A study is made of the use of an antisymmetric doublet lens to reconstitute the waists of a beam with their original shape and spacing. Various properties of the symmetric triplet lens are explored, especially the dependence on waist shape of the boundary between regions of real and complex solution in lens-strength space. The calculations are carried out in the approximation in which the field near the axis of a quadrupole lens is uniform within an effective length and zero outside. (auth)

25720 (BNL-13478) THE BROOKHAVEN ON-LINE DATA FACILITY. Love, W. (Brookhaven National Lab., Upton, N. Y.). Mar. 1969. 15p. (CONF-690301-2). Dep. CFSTI.

From Conference on Computer Systems in Experimental Nuclear Physics, Skytop, Pa.

After a brief review of the history of the BNL On-Line Data Facility a description is presented on the present configuration. (B.G.D.)

25721 (CEAL-1047) SEMIANNUAL REPORT, JULY 1-DECEMBER 31, 1968. (Cambridge Electron Accelerator, Mass.). Feb. 12, 1969. Contract AT(30-1)-2076. 56p. Dep. CFSTI.

The semi-annual report is presented in seven parts. Part 1 indicates the purpose of the contract, which is concerned with the operation of the 6-GeV Cambridge Electron Accelerator, and lists the main guiding committees. Part 2, on accelerator operation, shows that the total number of prime-user hours and parasite-user hours of accelerator operation in the six-month period was 2590. Part 3 describes the 25 experiments underway or in preparation. Part 4 summarizes progress on the colliding beam facility (Project Bypass). Part 5 summarizes major improvements and new projects. Part 6 deals with safety. Part 7 lists the major publications. (B.G.D.)

25722 (CERN-69-4) STUDY OF THE MULTIPLE PLATE ELECTROSTATIC SEPARATION. USE FOR BEAM ENRICHMENT AT LOW ENERGIES AND HIGH INTENSITIES. Simon, D. J. (European Organization for Nuclear Research, Geneva (Switzerland)). Mar. 21, 1969. 57p. (In French). Dep.

The study of the multiple plate electrostatic separator and its use for beam enrichment at low energies and high intensities covers feeding of the plates, hypotheses for high voltage and beam optics, method for studying the performance, and long and the short multiplate separators, comparison with a classical electrostatic separator, and experimental studies. (J.F.P.)

25723 (DESY-68/58) THE MESOTRON, AN ELECTRON ACCELERATOR FOR HIGH FINAL ENERGIES. Bathow, G.; Freytag, E.; Wuester, H.-O. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Dec. 1968. 17p. (In German). Dep.

The circular electron accelerator described is characterized by the following properties: the energy gain per turn is an appreciable fraction of the final energy; thus the electrons perform only a small number of turns, electrons in different turns are simultaneously accelerated in linear accelerator structures, and electrons of different energies are focussed on separated orbits; thus dc-powered magnets may be used in the circular sections. Comparison of the proposed accelerator with the conventional synchrotron and the linear accelerator is made and the possible advantages are discussed. The use of superconducting acceleration structures would allow a duty-cycle of 100%. In this case the proposed accelerator is expected to have economical advantages compared to a superconducting linear accelerator of the same duty-cycle for energies up to approximately 60 GeV. Finally, the possible application for proton acceleration is pointed out. (auth)

25724 (IAE-1667) CALCULATION OF THE FOCUSING PROPERTIES OF SECTOR MAGNETIC AND ELECTRICAL FIELDS OF AXIALLY SYMMETRIC TYPE WITH CURVED-LINE BOUNDARIES (MONOCHROMATORS, ANALYZERS, SEPARATORS, MIRRORS, AND OTHER SYSTEMS FOR THE CHANNELIZATION OF BEAMS OF CHARGED PARTICLES). Panin, B. V. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1968. 100p. (In Russian). Dep.

On the basis of Artsimovich's principle for calculating the focusing of divergent, charged-particle beams, an expression was developed for determining aberrations in axial-symmetric systems with straight-line boundaries. This problem was further examined by developing an ion-optical scheme, involving both crossed and separate magnetic and electric axial-symmetric fields with curved boundaries. Only boundaries, the equations of which may be expressed as polynomes in cylindrical coordinates, were considered. The properties of the ion-optical system which depend only on their geometric parameters were analyzed, neglecting the terms in the equation of motion which involve the interaction of the focusing particles and the collective processes of the beam-plasma system. The method obtained was found to be well suited to calculate a large number of analyzing and guiding systems for nonrelativistic charged-particle beams. (TTT)

25725 (INR-958) BETATRON 30 MeV. Janiczek, J.; Kielsznia, R. (Institute of Nuclear Research, Warsaw (Poland)). 1968. 15p. (In Polish). Dep.

In this paper 30-MeV betatron working in the Institute of Nuclear Research is described. The technical and operating data and description of more important parts of betatron are given. (auth)

25726 (LNF-68/70) TECHNICAL REPORT ON THE APPARATUS FOR AN EXPERIMENT OF TWO π^0 PHOTOPRODUCTION IN HYDROGEN WITH A HEAVY LIQUID BUBBLE CHAMBER. PART I. THE HYDROGEN TARGET. Note No. 419. De Schryver, S.; Fiore, L.; Lodi-Rizzini, E.; Mantovani, G. C.; Modena, I.; Piazza, A.; Scaramuzzi, F.; Susinno, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Nov. 26, 1968. 8p. Dep.

The construction of a hydrogen target to be inserted in a freon bubble chamber is described. The problems posed by the use of a photon beam are discussed. The best solution seems to be a thin-walled gaseous target at high pressure placed in a small region near the chamber center. The results of a Monte Carlo efficiency calculation are also reported. The apparatus will be used at the Frascati Electronsynchrotron to investigate the double π^0 photoproduction on protons. (auth)

25727 (LNF-69/2) A MAGNETIC ANALYZER TO BE USED FOR ADONE COLLIDING BEAM EXPERIMENTS. Note No. 425. Ash, W.; Grossman, D.; Matthiae, G.; Murtas, G. P.; Nigro, M.; O'Neill, G. K.; Sacerdoti, G.; Santangelo, R.; Scannicchio, D.; Schiavuta, E. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Jan. 7, 1969. 46p. Dep.

A detection apparatus for analyzing particles produced in e^+e^- collisions in Adone at energies between 0.75 and 3.0 GeV is described. This apparatus is particularly suited for momentum and direction measurements of charged particles, γ-ray detection with localization of the materialization point, and range measurements and detection of nuclear and electromagnetic interactions. The apparatus consists of a large cylindrical coil which produces a 4.5kG magnetic field in its interior and a spark chamber system placed inside and outside of the coil. The internal spark chambers with thin electrodes measure initial direction and the momentum of the charged particles. In the external thick plate spark chambers the γ-ray convert and the charged particles are further analyzed. Design modifications are presented for the solenoid mounted perpendicular to the Adone straight section (transverse case) and an appendix is included which treats those features in which the longitudinal case differs. (B.G.D.)

25728 (MORP-68-2) RECOMMENDATIONS FOR THE SAFE OPERATION OF PARTICLE ACCELERATORS. Gundaker, Walter E.; Boggs, Richard F. (National Center for Radiological Health, Rockville, Md.). Feb. 1968; Reprinted Sept. 1968. 14p.

Recommendations pertaining to the basic administration and minimum procedures that should be followed at particle accelerator facilities to insure safe operation are presented. The recommendations are designed to supplement existing regulations and standards. The report is intended for use by radiation safety personnel and accelerator users. (auth)

25729 (NP-17803) SIMULATION OF A VORTEX ELECTRICAL FIELD IN AN ELECTROLYTIC BATH. Vakhrushin, Yu. P.; Semenov, O. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Leningrad). 1968. 13p. (In Russian). Dep.

Linear induction accelerators have been proposed to create electron beams with relativistic energies by means of vortex electric fields. The difficulties in the calculation of these fields may be simplified by making use of the similarity with static electric and magnetic fields which are based on the same equations and boundary conditions. Such a model was developed on the basis of electric vortex fields generated by a series of pulse transformers in electrolytic system. The results were used to determine the accelerating field of the LIU-3000 linear accelerator, comparing it with the accelerating portion of the Astron machine. A model was built to obtain the tension of the electric vortex field excited by 12 magnetic toroids surrounded by a conductive shell, using an ac bridge with an oscillograph as the zero indicator to determine the equipotential lines. The system made it possible to determine the conditions under which the field becomes strongly nonuniform. (TTT)

25730 (PPAD-657-D) ADDITION OF AG FEATURES TO PPA. Prelec, K.; Passner, A. (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Jan. 17, 1969. Contract AT(30-1)-3217. 29p. Dep. CFSTI.

Results of numerical calculations performed for two different strong focusing additions to the Princeton-Pennsylvania Accelerator are presented. One is an alternating structure achieved by means of either pole face windings or pole face tips (the latter would convert PPA into an AG machine), and the other is a double spiraling quadrupole system, which in its ideal form is equivalent to a quadrupole with continuously changing gradients. The second system is referred to as the azimuthally varying (AV) quadrupole. (auth)

25731 (SLAC-98) TWO-MILE ACCELERATOR PROJECT. Quarterly Status Report, October 1-December 31, 1968. (Stanford Linear Accelerator Center, Calif.). Mar. 1969. Contracts AT-(04-3)-400; AT(04-3)-515. 67p. Dep. CFSTI.

A status report on the Stanford Linear Accelerator Project covering the period October 1, 1968 to December 31, 1968 is presented. Topics included are accelerator and research area operations, accelerator and research area equipment development, and physics research equipment development. (auth)

25732 (SLAC-PUB-559) THE ON-LINE CONTROL, ANALYSIS, AND DISPLAY SYSTEM FOR THE SLAC MULTI-GeV/c SPECTROMETERS. Boyarski, A. (Stanford Linear Accelerator Center, Calif.). Mar. 1969. 36p. (CONF-690301-3). Dep. CFSTI.

From Conference on Computer Systems in Experimental Nuclear Physics, Skytop, Pa.

An on-line experimental system is described which consists of an SDS9300 with 32K core, an extensive set of peripherals, software including an assembler, a real time FORTRAN IV compiler, a disk monitor, and a multiplexed interface system able to com-

municate with over 300 devices each having up to 24 bits of information. (B.G.D.)

25733 (UCRL-17941) 1966 CERN-LRL-RHEL SHIELDING EXPERIMENT AT THE CERN PROTON SYNCHROTRON. Gilbert, William S. (California Univ., Berkeley. Lawrence Radiation Lab.); Shaw, Kenneth B. (Rutherford High Energy Lab., Chilton (England)); Fortune, Ronald D.; (and others) (European Organization for Nuclear Research, Geneva (Switzerland)). Sept. 1968. Contract W-7405-eng-48. 358p. Dep. CFSTI.

The high cost of shielding of high-intensity accelerators in the 100-GeV energy range has stimulated keen interest in the radiation problems associated with these accelerators. As of 1966, available experimental data were perplexing and even conflicting. To resolve these difficulties, three laboratories—CERN, Lawrence Radiation Laboratory, and the Rutherford High Energy Laboratory combined their resources in the latter part of 1966 to carry out an extensive study of many of the major uncertainties in the radiation environment of the 28-GeV CERN proton synchrotron (CPS). Proton beam loss, neutron spectra, radiation levels in the accelerator room, and transmission of radiation through earth shielding and along tunnels were measured at 14.6 and 26.4 GeV/c. The volume of data obtained was so great that analysis and publication has required nearly two years. In the course of data reduction, computer programs for the evaluation of neutron spectra were developed and a study made of the conversion of neutron spectra information to dose equivalent. Useful information was obtained on the distribution of beam loss around the vacuum chamber of the CPS. The data obtained have been qualitatively explained by Monte Carlo calculations due to Ranft. The transmission of radiation through the earth shield was analyzed by a computer program FLUXFT through generalization of an empirical model first used by Moyer. Excellent agreement is obtained with the experimental data. The success of the model in explaining the observed radiation field at the CPS gives confidence in extrapolation to accelerators in the energy region around 200 GeV. The transmission of radiation along tunnels was studied and successfully interpreted in terms of a simple model. All data used in the analysis programs, as well as almost all other data, are presented in tables. (auth)

25734 (UCRL-18489) APPLICATION OF THE TWO-POWER-SUPPLY METHOD TO THE FERRITE BIAS OF AN RF RESONATOR OF A RAPID-CYCLING SYNCHROTRON. Reginato, Louis L.; Smith, Bob H. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 3, 1969. Contract W-7405-eng-48. 7p. Dep. CFSTI.

The ferrite bias equipment for the rf resonators of high-repetition-rate synchrotrons is expensive. This is a result of the high voltage necessary to overcome the back emf of the unsaturated ferrite at the beginning of the sweep, and the high current necessary to saturate the ferrite at the end of the sweep. The high frequency resonators of the Omnitron, which sweep in 8 ms, require 70 V initially, but only 20 V after the first 2 ms, when the current reaches 5 kA. The voltage remains low for the remainder of the sweep, while the current increases to 20 kA. To meet these requirements as inexpensively as possible, a pulse-type power supply is used during the first 2 ms, and a high-current power supply through the remainder of the sweep. Smooth current transfer is an inherent property of the circuit. Inductance, which is surprisingly costly, is kept to a minimum by a "sandwich" bus bar technique. A silicon-controlled-rectifier (SCR) switch reverses the current every other sweep so that the full hystereses loop of the ferrite is used. A regulator circuit forces the bias current to follow a reference pulse. (auth)

25735 (UCRL-18493) APPLICATION OF TELEPHONE CROSSBAR RELAYS TO COMPUTER CONTROL OF A PARTICLE ACCELERATOR. Davis, James W.; Dexter, Warren L.; Smith, Bob H. (California Univ., Berkeley. Lawrence Radiation Lab.). Jan. 31, 1969. Contract W-7405-eng-48. 25p. Dep. CFSTI.

A prototype automatic control system using crossbar relays for switching was built for experimental study. Eleven sets of these highly reliable and inexpensive relays can provide computer or manual access to the control of 1000 magnets or other regulated systems. The system consists of a computer, several manual-control panels, a set of crossbar relays, digital regulator references and actuating devices, and a corresponding readback system. The manual-control panels contain an address keyboard, which controls the crossbars, and a data-entry keyboard. The data are routed to the desired regulator reference or actuator. Since any number of manual-control panels may be used, each maintenance specialty can have its own control of the accelerator on "down" days. For automatic operation the computer simply replaces one of the manual-control panels. The coil-to-contact isolation in the regulator reference chassis and digital readout systems provide essentially infinite noise isolation between the accelerator and the control system. Without the computer the cost is comparable to a conventional manual-control system. Design considerations of the special devices which are unique to this type of control are included. (auth)

25736 (UCRL-18608) DESIGN AND CONSTRUCTION OF THE AXIAL INJECTION SYSTEM FOR THE 88-INCH CYCLOTRON. Clark, D. J.; Burger, R.; Carneiro, A.; Elo, D.; Frazier, P.; Luccio, A.; Morris, D.; Renkas, M.; Resmini, F. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1969. Contract W-7405-eng-48. 10p. Dep. CFSTI.

A new axial injection system for the 88-inch cyclotron has been constructed. It transports beams from external ion sources axially through the magnet yoke to the median plane of the cyclotron. The optical elements include a bending magnet, electric quadrupoles, and the magnetic field of the cyclotron. Beam monitoring is done with scanning wires, phosphor plates and Faraday cups. (auth)

25737 (UCRL-71542) ACTIVE METAL BRAZING TECHNIQUE FOR METAL-TO-NONMETAL SEALS. Bulmer, Richard H. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 27, 1969. 9p. (CONF-690407-6). Dep. CFSTI.

From Symposium on Engineering Problems of Fusion Research, Los Alamos, N. Mex.

The new Astron accelerator requires a large ceramic-metal stack assembly for the electron gun accelerating column. Vacuum-tight joining of the metal and nonmetal elements of the stack will be done by the active metal brazing technique. This technique has proved to be successful previously on smaller assemblies. In the assembly, machined copper rings are sandwiched between $15\frac{1}{2}$-in.-o.d. alumina rings, resulting in an $18\frac{1}{4}$-in.-high stack with 24 brazed joints. The assembly must be aligned within 0.015 in. and must be vacuum tight against an external pressure of 3 atm. A vacuum furnace capable of 900°C with high pumping speed in the 10^{-5} torr range is required for the brazing operation. The high pumping speed is necessary to reduce the pressure resulting from evolution of hydrogen from the titanium hydride flux used for brazing. A cold-wall furnace employing refractory metal heat shields, which was designed and built specifically for this brazing operation, is described. (auth)

25738 (UCRL-71552) ANALYSIS OF FLUX REVERSAL IN TAPE CORES. Winter, S. D.; Kuenning, R. W. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 27, 1969. 10p. (CONF-690407-16). Dep. CFSTI.

From Symposium on Engineering Problems of Fusion Research, Los Alamos, N. Mex.

Part of a study on magnetic cores which are used to couple energy to the beam in the Astron accelerator was the development of a theory explaining the drive requirements of the cores. The cores consist of 1-mil 50-50 NiFe tape, $\frac{1}{2}$ inch wide, wound spirally to form a toroid having a rectangular cross-section with typical i.d. and o.d. dimensions of $8\frac{1}{2}$ and 24 inches, respectively. These cores have sufficient flux to support a 10-kV pulse for 400 nsec; however, during the pulse, there is an increase of current losses within the tape and more and more drive current is required to maintain constant voltage output. An existing theory on flux reversal, the saturation-wave theory, predicts just such an increase throughout the pulse for cores with an aspect ratio (o.d./i.d.) of 1. To obtain quantitative results for the Astron cores, first it was necessary to extend the theory to include an aspect ratio greater than 1. Excellent agreement was then achieved between predicted and measured values of good cores during the latter part of the pulse. Next, a threshold level of the magnetic field to cause a change of induction in the tape was introduced which led to close agreement between the predicted and measured currents throughout the entire pulse. Comparison of predicted and measured currents are given for both good and bad cores with a qualitative discussion on the causes of bad cores. (auth)

25739 (UCRL-71553) EXPERIMENTAL STUDY OF 50–50 Ni–Fe TAPE-WOUND MAGNETIC CORES FOR THE ASTRON ACCELERATOR. Berg, Gary G. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 1, 1969. 9p. (CONF-690407-5). Dep. CFSTI.

From Symposium on Engineering Problems of Fusion Research, Los Alamos, N. Mex.

Two of the fundamental limitations on the Astron accelerator have been the poor quality and uniformity of pulse properties in the accelerator cores. An experimental and theoretical study to improve these properties was undertaken. The primary goal of the study was to determine which parameters affect the excitation current of a 1-mil tape-wound core when it is energized by kilovolt pulses. The most significant conclusion from the research is that eddy currents form the dominant component of excitation current. Furthermore, eddy currents in several adjacent, poorly insulated turns of tape seem to be the prime cause of the lack of quality and uniformity of cores. Following this core study, an order for 266 cores was placed, and for the first time, manufac-

turers had the knowledge to respond to performance specifications. The contractor was provided with special pulse test equipment so that cores could be tested and reprocessed, if necessary, until they did meet these specifications. Consequently, cores of higher quality were purchasable. (auth)

25740 (UCRL–71568) EXTENSION OF THE ASTRON ACCELERATOR TO 8 MeV. Saunders, Kenneth A. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 27, 1969. 12p. (CONF-690407–13). Dep. CFSTI.

From Symposium on Engineering Problems of Fusion Research, Los Alamos, N. Mex.

The increase in beam energy from 4 to 8 MeV requires essentially doubling the number of magnetic cores in the Astron accelerator at Lawrence Radiation Laboratory, University of California, Livermore. These cores are reconnected so that each pulser drives two cores in series instead of using a pulser for each core. Doubling the magnetic material results in a lower excitation current, thus providing a higher accelerating potential from each of the pulse generators. In this way the beam energy is doubled, with the major addition being passive components and a very modest increase in active electronics. (auth)

25741 DETERMINATION OF TRANSVERSE POLARIZATION OF HIGH ENERGY ELECTRONS. Baier, V. N.; Khoze, V. A. (Novosibirsk State Univ., USSR). Yadern. Fiz., 9: 409-12(Feb. 1969). (In Russian).

Various experiments in which the transverse polarization of high energy electrons in storage ring can be determined, are discussed. (auth)

25742 ENERGY-LOSS SPECTRA FOR HIGH-ENERGY ELECTRONS AS A FUNCTION OF DEPTH IN AN ABSORBER. Olien, T. C.; Holloway, A. F. (Manitoba Cancer Treatment and Research Foundation, Winnipeg, Can.). Radiat. Res., 38: 1-6(Apr. 1969).

Collimated beams of electrons with energies of 20 and 35 MeV were available from a betatron used for radiotherapy. A semiconductor detector was used to obtain the spectrum of energy deposits by electrons in its 450-μm thickness. The detector was placed behind Lucite to observe the change in spectra with depth. Features of the spectra were compared with results predicted by calculations. The qualitative influence of secondary electrons was noted. (auth)

25743 ABSORPTION OF 20-eV TO 50,000-eV ELECTRON BEAMS IN AIR AND PLASTIC. Cole, Arthur (Univ. of Texas, Houston). Radiat. Res., 38: 7-33(Apr. 1969).

Absorption in air and plastic of 20-eV to 50,000-eV monoenergetic electron beams was studied. A cylindrical ionization chamber operated at 10^{-3} to 250 torr was used to measure absorption in air. The average energy expended per ion pair, $\overline{W}$, was found to increase, with decreasing electron energy, from 33.5 eV/ion pair at 10,000 eV, to 52 eV/ion pair at 100 eV, to 74 eV/ion pair at 20 eV. Electrons transmitted and reflected by plastic foils and the ionization produced by the electrons were determined for foils from 0.24 $\mu g/cm^2$ to 5,240 $\mu g/cm^2$. The electron range, R, in units of 100 $\mu g/cm^2$ (equivalent to microns at unit density) for air and plastic was found to depend on electron energy, E, in keV, as $R = 0.0431(E + 0.367)^{1.77} - 0.007$, for E between 20 eV and 100-keV. A corresponding stopping power, dE/dX, in keV cm^2 per 100 μg was found to fit the relation $dE/dX = 13.05(E + 0.367)^{-0.771}$. Estimates were made of the energy transmitted, reflected, and locally absorbed for 150-eV to 50,000-eV electron beams in collodion. Particle energy losses of 100 keV per micron of absorber thickness were determined for electron energies below 500 eV. (auth)

25744 AN AMPROVED AUTOMATIC DEFLECTOR OF THE ROSSENDORF CYCLOTRON. Borkenhagen, M.; Ernst, D. (Zentralinstitut fuer Kernforschung, Dresden). Kernenergie, 12: 18-21(Jan. 1969). (In German).

Electric equipment is described for automatically conditioning the deflecting system of the Rossendorf cyclotron with respect to its voltage strength. Along with this, protection of the deflecting system against destruction by voltage breakdowns is realized. High reliability of operation in various conditions is obtained by using contact instruments. The functional state of the deflector insulators is permanently controlled by indication of the insulation current. (auth)

25745 RESOLUTION PROPOSING AMENDMENTS TO THE CONVENTION FOR THE ESTABLISHMENT OF A EUROPEAN ORGANISATION FOR NUCLEAR RESEARCH, DONE AT PARIS ON 1ST JULY 1953. Atomic Energy Miscellaneous No. 6(1969). London, Her Majesty's Stationery Office, 1969. 16p. 2s.

Reference is made to amendments recommended by CERN the primary purpose of which is to allow CERN to operate more than one major laboratory and to widen the range of options open to members by enabling them to participate in a limited number of CERN programs. The amendments also seek to strike a balance between safeguarding the rights of participants in a particular program as a group and the CERN membership as a whole. It is stated that the amendments are necessary before work on the proposed 300 GeV laboratory can proceed. The UK has not accepted the amendments. (UK)

25746 ACCELERATION OF ELECTRONS BY AN ELECTRODYNAMIC SPACE–CHARGE EFFECT. Heese, N. R.; Raudorf, W. R. (Sir George Williams Univ., Montreal). J. Phys., D (London), 2: 717-24(Mar. 1969).

The acceleration method described is based on the transfer of the energy of a stream of electrons to the electrons at the front of the stream. The device used to demonstrate this method comprises a cathode at one end of a 130 cm long evacuated brass tube of 1.6 cm inner diameter, a tubular decelerator electrode at the other end and a solenoidal coil around the grounded tube to produce an axial focusing magnetic field. Electrons drawn from the cathode form a cylindrical stream. The decelerator is negative with respect to the cathode and the retarding electric field stops the arriving electrons. The running-on of the succeeding electrons causes the charge density within the front portion of the beam to grow and the potential to drop until a virtual cathode is formed, the potential of which is far below that of the decelerator. Electrons ahead of the virtual cathode are accelerated into and through the decelerator. Their energies were measured by electric and magnetic deflection methods. The device operated with −300 V between the grounded tube and cathode and −900 V between tube and decelerator. A beam current of 10 mA and a flux density of the focusing magnetic field of 260 g accelerated electrons to energies above 6 keV. (auth) (UK)

25747 FROM 500 MeV TO 2500 MeV. THE DEVELOPMENT OF HIGH-ENERGY PHYSICS IN BONN. Althoff, Karlheinz. Arbeitsgemeinsch. Forsch. Landes Nordrhein-Westfalen, No. 175, 7-19(1967). (In German).

The 500-MeV Electron Synchrotron of the Physikalisches Institut der Universität Bonn started to operate in 1958. This was the beginning of experimental high energy physics in Germany. The design of a 2.5 GeV-Elektron-Synchrotron began in 1964. The machine was completed at the end of 1966. The construction and the performance of the machine will be discussed. (auth)

25748 THICK TARGET NEUTRON YIELDS AND NEUTRON SPECTRA PRODUCED BY 20 MeV ^{3}He IONS, 14 MeV PROTONS, AND 7.5 MeV DEUTERONS ON A BERYLLIUM TARGET. Bruninx, E.; Crombeen, J. (Philips Research Labs., Eindhoven, Netherlands). Int. J. Appl. Radiat. Isotop., 20: 255-64 (Apr. 1969).

Fast neutrons were produced in a beryllium target by 20 MeV ^{3}He ions, 14 MeV protons and 7.5 MeV deuterons. The energy spectrum was measured by means of nuclear reactions with different thresholds, and yielded average fast neutron energies of respectively 7.8, 2.0 and 2.5 MeV. The measured angular distributions were used for determining the absolute neutron yields, there being respectively 1.3×10^9, 6×10^{10} and 1.4×10^{10} neutrons/sec $4\pi \cdot \mu A$. The advantages and disadvantages of fast neutrons of this type as compared with those from traditional 14 MeV neutron generators are pointed out. (auth) (UK)

25749 FOCUSING AND CHROMATIC ABERRATION OF PARTICLE BEAMS IN PERIODIC APPARATUS. Gouiran, R. (CERN, Geneva). Ann. Phys. (Paris), 3: 67-87(Mar.-Apr. 1968). (In French).

Thesis.

The theory of alternating gradient accelerators is used for particle beam transport through a regular succession of quadrupolar lenses. One gives the parameters β and μ for some systems. The acceptance of such a channel is computed as well as its chromatic deformations when the momentum p varies. Then one considers a beam having an elliptical emittance and one studies the transmission of this ellipse through the channel. One gives a simple expression of deformations and loss of area of this ellipse when p varies and one deduces a theorem explaining the matching conditions which minimize these deformations and even cancel them, for the first order in $\Delta p/p$. One also studies image enlargements due to chromatism when the emittance is elliptical. Appendix one gives some precision on invariant ellipses, phase space normalization, and ellipse transformation through phase space. (auth)

25750 POSITRON BEAMS. Yount, David E. (Stanford Linear Accelerator Center, Calif.). Phys. Today, 22: No. 2, 41-9(Feb. 1969).

The review of positron beams covers collision and pair production, converter materials, positron acceleration, the coaxial

solenoid, and quadrupole focusing. Also experiments using positron beams, storage rings, and annihilation photons are considered. (J.F.P.)

25751 STATIC COMPRESSION OF RELATIVISTIC-ELECTRON RINGS. Christofilos, Nicholas C. (Univ. of California, Livermore). Phys. Rev. Lett., 22: 830-3(Apr. 21, 1969).

A variation of Veksler's "collective-ion acceleration" principle by which electrons of energy 100 to 1000 MeV are injected in a static magnetic field to form an electron ring of rather large initial diameter is described. The electron ring then is subjected to successive axial accelerations taking place at constant radius in a decreasing magnetic field, and decelerations taking place in an increasing magnetic field under adiabatic conditions. The functional dependence of the electrons' azimuthal mechanical momentum on the axial magnetic field is different for the two field configurations, and the result is a net compression of the electron ring at the end of each stage of axial acceleration and deceleration. (auth)

25752 NUCLEAR STRUCTURE INVESTIGATIONS WITH MODERN ACCELERATORS. Mayer-Kuckuk, Theo. Arbeitsgemeinsch. Forsch. Landes Nordrhein-Westfalen, No. 175, 21-58 (1967). (In German).

First the general situation of nuclear physics is discussed briefly. Then the impact of modern accelerator technology on nuclear structure studies is demonstrated on a few specific examples (cross section fluctuations, isobaric analogue states). Finally some properties of isochronous cyclotrons and the application of these accelerators are described. (auth)

25753 DEVICE FOR ATTENUATING THE RADIO WAVES. Takeda, Yasutsugu (to Hitachi Ltd.). Japanese Patent 1968-28517. Dec. 7, 1968. Filed Oct. 24, 1964.

The device proposed can be used for small linear particle accelerators such as for radiography or medical purposes. The advantages are a high absorption of the accelerating high-frequency radio waves, high cooling effect, compactness, and low cost. The radio-wave attenuating device consists of the following: a plurality of cylinders of a high heat-conductivity and nonmagnetic material; a plurality of discs of the same material with a central hole (both arranged alternately on a line); and a thin coating of a high magnetic-permeability material applied partly or wholly onto the inner surface of the cylinders and discs. (NSA of Japan)

25754 PARTICLE ACCELERATOR. Tawara, Hiroyuki (to Hitachi Ltd.). Japanese Patent 1969-77. Jan. 6, 1969. Filed June 21, 1965.

In the particle accelerator, including a dc high voltage generator, an ion source, an accelerating tube, an irradiation room and a beam control, the diameter of a beam to irradiate a sample material is adjusted by changing the length of the cathode. A cathode, in the form of bellows, is employed for this purpose, being fixed on the end of an accelerating tube within the tube; the length of the cathode can be easily changed from outside the accelerating-tube end. (NSA of Japan)

25755 SOME CHARACTERISTICS OF ELECTRON LINAC FOR NON-DESTRUCTIVE INSPECTION MODEL ML-15R. Minamoto, Shin-ichi; Osaka, Seiji (Mitsubishi Heavy Industries, Ltd., Kobe, Japan. Kobe Shipbuilding and Engine Works, Japan). Mitsubishi Denki Giho, 43: 465-71(Mar. 1969). (In Japanese).

Design and performance of non-destructive inspection apparatus with electron linac is reported. Main feature of this apparatus, using a 5 MW klystron as the microwave power source, is its ample output and steady operation. The accelerator unit, about 3 m in length, can be driven in three direction and rotated in horizontal and vertical planes. The maximum energy of electron beam is 12 MeV, and x-ray output is continuously varied in the wide range from 2,000 to 10 R/min at 1 m. The focal spot size is not larger than 2 mm in diameter and the sensitivity of flaw detection is better than 1%. The performance of this machine, which enables us to inspect steel plate of 350 mm thickness within 10 minutes, and its characteristics of radiography are described. (auth) (UK)

25756 BEAM CONTROL IN A PROTON SYNCHROTRON. van Kampen, Willem Antoon. Delft, Netherlands, Technische Hogeschool, 1969. 97p.

Thesis.

The analysis and design of a beam control system of a proton synchrotron are presented. The equations of the synchrotron motion are derived and the electric signals from the beam analyzed. The important equipment is discussed briefly. The system of particles and electronic equipment is described by means of nonlinear differential equations with time dependent coefficients. Design criteria and a method to determine the system parameters are derived. A Liapunov function is constructed to prove the stability of the phase control loop, and to determine the stable regions in the machine as well as the stable particle distributions. The results are valid for a system with time dependent parameters such as appear during acceleration. A special feature of the Delft Proton Synchrotron is take-over, i.e., the change of harmonic number during acceleration. The optimalization of the take-over, leading to very high efficiencies is described. A computer model is described which was used to simulate take-over. The results are fully in accordance with those obtained during the experiments. Finally some results of the Delft Proton Synchrotron are shown as obtained with the beam control system which has been built after the above mentioned design criteria. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 24457, 24496, 25748, 25801, 25937, and 26086.

25757 (BNL–13422) SOME MATHEMATICAL CONSIDERATIONS ON CAUCHY INTEGRALS RELATED TO PULSED NEUTRON DISPERSION RELATIONS. Dorning, J.; Nicolaenko, B.; Thurber, J. K. (Brookhaven National Lab., Upton, N. Y.). Jan. 1969. 45p. (CONF-690108–2). Dep. CFSTI.

From Conference on Transport Theory, Blacksburg, Va.

Mathematical methods are discussed for dealing with Dispersion Relations, Analytic Continuations, Cauchy Integrals, "Pseudo-Modes," and all that ... A salient feature is the outline of a method to obtain the "Puiseux Expansion" of a Cauchy integral around its branch-point. Such an expansion, made with a set of simple multi-valued functions, has the good fortune to be valid in both physical and nonphysical Riemann sheets. (auth)

25758 (IN–1123) LIBMOD: A FORTRAN-IV PROGRAM FOR MODIFICATION OR CREATION OF INCITE CROSS SECTION LIBRARIES. Curtis, R. L.; Grimesey, R. A. (Idaho Nuclear Corp., Idaho Falls). Mar. 1969. Contract AT(10-1)-1230. 82p. Dep. CFSTI.

The LIBMOD code was written to satisfy the need for a general means of updating the cross section library used by the INCITE code. The required procedures as well as the equations involved in creating and modifying the cross section data are described in detail. The program contains logic to process absorption, fission, and elastic and inelastic scattering cross section data. In addition, logic was provided for the calculation of total scattering cross sections from differential scattering data, slowing down sources into the thermal energy range assuming a 1/E flux above the upper cutoff energy, and gas model differential scattering data utilizing either the Wigner-Wilkins or Brown and St. John prescriptions. The present version of the code is set up to handle the zeroth and first Legendre moments of the scattering cross sections and sources. The LIBMOD code is written in the FORTRAN-IV language and versions have been written for both the IBM-360/75 and the IBM-7040 digital computers. (auth)

25759 (IN–1269) CALCULATED NORMAL FREQUENCIES AND NEUTRON SCATTERING LAW FOR BENZENE. Marsden, R. S. (Idaho Nuclear Corp., Idaho Falls). Mar. 1969. Contract AT(10-1)-1230. 62p. Dep. CFSTI.

Two complete sets of normal modes and frequencies were calculated for a benzene molecule. The first set gives good agreement with the assigned frequencies of Crawford and Miller for the planar vibrations and of Herzberg for the nonplanar vibrations. The second set gives good agreement with the frequency assignments of Shimanouchi. These normal modes and frequencies were then used to calculate the slow neutron scattering properties of a free gas of benzene molecules. The scattering law, which presents the double differential cross section in terms of the energy and the momentum changes, was calculated for each set of frequencies and modes. The values calculated using the Crawford and Miller–Herzberg assignments are in reasonable agreement with measurements for liquid benzene in those regions of energy and momentum transfer where the intermolecular forces of the liquid state can be neglected. Use of the Shimanouchi frequency assignments gives considerably poorer agreement with the measurements. Therefore, for the other scattering properties only the Crawford and Miller–Herzberg assignments were used. The calculated values of the total cross section are in good agreement with measured values. Calculated values of the average cosine of the scattering angle and of the diffusion coefficient are somewhat higher than values deduced directly from measured cross sections. A thermal neutron spectrum and pulsed neutron parameters calculated from the scattering law agree fairly well with measurements. (auth)

25760 (RT/FI–(68)32) EFFECTIVE SOLUTIONS TO THE PROBLEMS OF NEUTRON TRANSPORT KINETICS IN ONE AND THREE DIMENSIONS. Mika, J.; Stankiewicz, R.; Trombetti, T. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 29p. Dep.

The time-dependent, space-angle-energy distributions of neutron flux in one and three dimensions were determined as the solutions of the corresponding initial value transport problems. In either case the solution is expressed as a sum of exponential modes plus a residual term which is shown to become asymptotically negligible. It is seen that these expressions are well suited, for practical engineering and physical purposes, to the investigation of the kinetic behavior of neutron flux distributions. (auth)

25761 (RT/FI–(68)49) EVALUATION OF NEUTRON SPECTRA BY ACTIVATION MEASUREMENTS OF SPECTRAL INDEXES. Pistella, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 61p. Dep.

Two different methods devised for spectrum evaluation by means of spectral indexes are described. According to the first scheme, a shape can be numerically inferred for the spectrum: a guess distribution is modified so that the measured values of the spectral indexes, and possible auxiliary conditions, are reproduced. In the second scheme, a direct correlation between spectral indexes and the reaction rate to be investigated is established; a range of possible values is determined for the unknown reaction rate by measured activation rate only, with no evaluation of the spectrum actually present in the assembly. (auth)

25762 (SRARI-P–22) AN ANALYSIS OF THE NONSTATIONARY KINETIC EQUATION OF NEUTRON TRANSPORT IN MODERATING AND MULTIPLYING MEDIA. Shikhov, S. B.; Shkurpelov, A. A. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1968. 80p. (In Russian). Dep.

The nonstationary process of neutron transport in a substance taking into account the dependence of the macroscopic cross sections upon energy and coordinates is considered. The spectral analysis of the neutron transport operator and the semi-group generated by it was carried out. Conditions at which the neutron transport operator has its real eigenvalue were obtained. The asymptotic behavior of the solution of the nonstationary equation at $t \to \infty$ was determined. (auth)

25763 CONSISTENCY OF CERTAIN APPROXIMATE SOLUTIONS TO THE TRANSPORT EQUATION. Erdmann, R. C. (Univ. of California, Los Angeles). J. Nucl. Energy, 23: 53-66 (Mar. 1969).

Several approximating techniques to finite slab problems are compared for consistency in the subcritical and critical states. It is found that certain techniques are valid throughout the subcritical range while others are only of limited applicability. These solutions are extended to the finite sphere, where similar conclusions are noted. The approximations can be conveniently divided into classes, each class being associated with a different critical condition. (auth) (UK)

25764 POLYNOMIAL APPROXIMATION FOR INTEGRAL TRANSPORT CALCULATIONS. Lewis, E. E. (Northwestern Univ., Evanston, Ill.). J. Nucl. Energy, 23: 87-97(Mar. 1969).

The integral transport equation is formulated for a Wigner–Seitz reactor lattice cell with either reflected or isotropic return boundary conditions. The equation is then reduced to a form suitable for numerical computation by dividing the cell into a number of concentric volume increments and approximating the scalar flux within each of these by a three-point interpolation polynomial. The procedure thus relaxes the flat flux assumption made for each volume increment in using conventional collision probability methods. One-group disadvantage factors are calculated for a slab and a cylindrical lattice using both the collision probability and the polynomial approximation methods. The polynomial approximation technique results in a substantial reduction in the computing time necessary to obtain the disadvantage factors to within a given accuracy. (auth) (UK)

25765 NEUTRON SCATTERING AND NATURE OF THE SOFT OPTICAL PHONON IN $SrTiO_3$. Yamada, Yasusada; Shirane, Gen (Brookhaven National Lab., Upton, N. Y.). J. Phys. Soc. Jap., 26: 396-403(Feb. 1969).

Measurements of neutron scattering from an $SrTiO_3$ crystal were carried out in the temperature range from 4.5°K to 300°K. The integrated intensity of inelastically scattered neutrons due to excitation of the soft optical phonon was observed at various reciprocal lattice points at room temperature. The structure factors deduced from the observed intensities are in qualitative agreement with Slater's model of ionic movement. A strong anisotropy of the dispersion surface of the soft mode in reciprocal space was observed around $q = 0$, the direction of the lowest frequency being along [100]. The intrinsic energy width of the soft mode shows a gradual increase with increasing temperature from 0.22 MeV (20°K) to 0.85 MeV (250°K). The experimental results indicate that in $SrTiO_3$, the polarization fluctuation is entirely due to the excitation of optical phonons and the phonon system can be treated as a quasi-harmonic system over the temperature range from 4.5 to 300°K. (auth)

25766 ERROR ESTIMATION FOR TIME-DEPENDENT MONTE CARLO LEAKAGE SPECTRA. Kschwendt, H. (EURATOM, Ispra, Italy). J. Nucl. Energy, 23: 67-72(Mar. 1969).

A formula is derived for the statistical error to be expected in the ELP (Expected Leakage Probability) method. This formula, though approximate, is in good agreement with the values obtained numerically. It is of practical interest since it avoids the necessity of evaluating the error by the usual storage consuming procedure. The storage saving can be illustrated by considering the problem of determining the current and transmission in both directions on the boundaries between 5 regions, assuming 50 time intervals and 15 energy groups. This would require 15,000 additional storage locations, which together with the program and the results themselves, is beyond the capacity of an IBM 7090 computer. The ELP method is used to predict the energy- and time-dependent leakage from a polyethylene sphere exposed to a monoenergetic neutron pulse. (auth) (UK)

25767 DEVELOPMENT OF PARTITION FUNCTION IN BOLTZMANN DISTRIBUTION. V. EXCHANGE CORRECTIONS. Fulinski, A. (Jagellonian Univ., Krakow). Acta Phys. Pol., 35: 75-82(Jan. 1969).

Corrections from the exchange diagrams to the previously obtained formula for the partition function Z are found. These corrections influence neither the properties of the leading diagrams nor the general form of the expression for ln Z. The effect of retaining them results only in a renormalization of the value of the parameter A of the theory. (auth)

25768 CRITICAL MAGNETIC SCATTERING OF NEUTRONS IN ANTIFERROMAGNETS. Kocinski, J. (Warsaw Technical Univ.); Wojtczak, L. Acta Phys. Pol., 35: 61-6(Jan. 1969).

The cross section for critical magnetic scattering of unpolarized neutrons in a two sublattice, spin $s = 1/2$, Heisenberg antiferromagnet, for temperatures above or at the Néel point, without external magnetic field was calculated on the basis of the previously derived general cross section formula and the previously developed description of the spatial and temporal behavior of thermodynamic fluctuations in antiferromagnetic order. The cross section was derived in two forms connected with the Ornstein–Zernike and $|\sin \kappa_0 r|/r$ spin correlations. In discussing these cross sections, emphasis is upon the second one. (auth)

25769 SOME ASPECTS OF THE THEORY OF THE SCATTERING OF NEUTRONS BY MAGNETIC IONS. Lovesey, S. W. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C (London), 2: 470-6(Mar. 1969).

The differential cross section for the elastic magnetic scattering by an ion with both spin and orbital angular momentum is expressed in the same form as for the "spin-only" case, the spin operator being effectively replaced in the general case by an operator $\hat{Q}$. Following Johnston (1966) an expression for the matrix elements of $\hat{Q}$ is given in terms of one set of radial integrals instead of the two sets introduced by Trammell (1953). An explicit proof is given of the equivalence of the calculations of the cross section by Johnston and by Trammell. (auth) (UK)

25770 SINGLE-SLIT DIFFRACTION OF NEUTRONS. Shull, C. G. (Brookhaven National Lab., Upton, N. Y. Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 179: 752-4(Mar. 15, 1969).

Observations are reported on single-slit diffraction of monochromatic slow neutrons (wavelength 4.43 Å) upon passage through fine slits of width between 21 and 4.1 μ. Gadolinium-edged slits were used because of the high-absorption cross section for this material, and the angular broadening effects in the range up to 20'' of arc were studied on a high-resolution double-crystal spectrometer utilizing perfect crystals of silicon. The observed broadening agrees well with that calculated, and this supplies evidence on the width of the coherent wavefront of a neutron wave packet. (auth)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstracts 25812, 25820, 25829, and 25961–25963.

25771 (JINR–P2-4333) INTERACTION CROSS SECTIONS OF NUCLEONS WITH HELIUM. Barashenkov, V. S.; Eliseev, S. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 7p. (In Russian). Dep.

The energy dependence curves of cross sections σ_t, σ_{in}, σ_{el} for the interaction of a nucleon with the ^{4}He nucleus are given. At higher energies the curves were calculated by the Glauber theory, while for the lower energies they were obtained by interpolation of known experimental data by means of optical model formulas. (auth)

25772 (JINR–P15-4299) ON CONSERVATION OF ISOTOPIC SPIN IN THE REACTION ^{3}He(t,d)^{4}He. Kim Syn Nam; Osetinskii, G. M.; Sergeev, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1969. 21p. (In Russian). Dep.

The angular distributions of deuterons from the reaction $^3\text{He} + {}^3\text{H} \rightarrow {}^4\text{He} + \text{D}$ were measured using the electrostatic generator of the Neutron Physics Laboratory (JINR) in the energy range of tritons 1 to 1.5 MeV. Within the experimental errors (1–1.5%) the angular distributions are symmetrical about 90° in the c.m.s. It is shown on the basis of Barshay-Temmer theorem that the symmetry obtained is due to the isospin conservation in the reaction studied. The upper limit of the amplitude ratio of forbidden and allowed isospin transitions is found to be ≈0.02. (auth)

25773 (LAL–1205) ELASTIC ELECTRON SCATTERING FROM ^{4}He. Vinciguerra, D.; Stovall, T. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). Dec. 1968. 8p. Dep. CFSTI.

The elastic electron scattering from ^{4}He is explained in a nuclear model which considers the nucleons as moving in space-fixed potentials. (auth)

25774 ANALYSIS OF INVESTIGATION OF THE REACTION D(d,p)T WITH POLARIZED DEUTERONS. Ad'yasevich, B. P.; Fomenko, D. E. (Inst. of Atomic Energy, Moscow). Yadern. Fiz., 9: 283-91(Feb. 1969). (In Russian).

Experimental data on the reaction D(d,p)T with polarized deuterons in the energy region from 100 up to 500 keV were analyzed. A formula was obtained which describes the differential partial cross section of the reaction D–D in case of a polarized deuteron beam. Experimentally measured cross sections were expanded in orbital momenta in the output channel of the reaction and absolute values of matrix elements for a number of transitions were obtained. By derivation, s, p, d waves were taken into account in the output and input channels of the reaction as well as the f wave interfering with the s, p waves in the output channel of the reaction. (auth)

25775 μ^- CAPTURE BY ^{3}He NUCLEUS. Goreslavskii, S. P.; Rozhnov, G. V. (Moscow Engineering-Physics Inst.). Yadern. Fiz., 9: 385-7(Feb. 1969). (In Russian).

The probability of μ^- meson capture by ^{3}He and the asymmetry coefficient of recoil nuclei from the capture of polarized muons were calculated with nuclear wave functions obtained from the solution of the Schroedinger equation for the three-nucleon system by the method of six-dimensional angular harmonics. (auth)

25776 PRODUCTION OF TRITIUM FROM BOMBARDMENT OF ^{4}He WITH 2.2-GeV PROTONS. Lebowitz, E.; Miller, J. M. (Columbia Univ., New York. Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 177: 1548-52(Jan. 20, 1969).

The cross section for the reaction $p + He \rightarrow {}^3\text{H} + 2N + X\pi$ was measured at 2.2 GeV using radiochemical techniques. The measurement gave a value of 30.2 ± 3.6 mb. This result is discussed in the context of previous measurements of cross sections for simple reactions with He and other nuclei. (auth)

25777 SEARCH FOR AN EXCITED STATE OF THE TRITON. Minehart, R. C.; Coulson, L.; Grubb III, W. F.; Ziock, K. (Univ. of Virginia, Charlottesville). Phys. Rev., 177: 1464-5(Jan. 20, 1969).

Upper limits for the formation of particle-stable and particle-unstable excited states of the triton in the reaction $\pi^- + {}^6\text{Li} \rightarrow {}^3\text{H} + {}^3\text{H}^*$ are given. (auth)

25778 COULOMB SCATTERING IN THE THREE-BODY PROBLEM. Adya, Shrikant (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 177: 1406-15(Jan. 20, 1969).

Using the Faddeev formalism for the three-body problem with two charged particles, with separable nuclear interactions and an approximate form for the Coulomb wave function and Coulomb Green's function, a simplified model is set up for p-d scattering. The differential scattering cross section is calculated numerically for different incident proton energies from 2.08 to 14.0 MeV. The calculations are repeated with the Coulomb potential turned off, and the results are compared with the Coulomb scattering. (auth)

25779 THEORY OF DEUTERON PHOTODISINTEGRATION AT HIGH ENERGIES. Dzhibuti, R. I.; Krupennikova, N. B.; Mamasakhlisov, V. I. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR, 52: 41-6(Oct. 1968). (In Russian).

At energies of E_γ greater than 100 MeV the experimental facts are not satisfactorily explained by the theory of deuteron photodisintegration. The interaction Hamiltonian of a gamma quantum with a deuteron is given without breaking down the vector potential according to multipolarities and with the exchange current

and the current caused by the Green potential being taken into account. The results show that delay effects must be taken into account in order to obtain the correct form of the angular distribution. The exchange forces of Majorana increase the total cross section in the region of E_γ greater than 100 MeV, and cause the appearance of an isotropic part in the angular distribution. If all these effects are taken into account simultaneously, there is a strong increase in the total cross section. (TTT)

25780 NONMESONIC DECAY OF HYDROGEN HYPERFRAGMENTS. Sorensen, R. G.; Holland, M. W.; Miller, H. G.; Roalsvig, J. P. (State Univ. of New York, Buffalo). Phys. Rev., 177: 1526-33 (Jan. 20, 1969).

Approximately 35,000 K^--capture stars in an emulsion stack were examined for hyperfragments. Using a mass selection criterion for all events, a sample of 13 π^- mesonic decays and one nonmesonic decay of hydrogen hyperfragments was identified for the purpose of estimating the relative rates of decay for the π^- mesonic and nonmesonic modes. (auth)

25781 FEW BODY PROBLEMS, LIGHT NUCLEI, AND NUCLEAR INTERACTIONS. VOLUME 1. Proceedings of the Symposium held in Brela, Yugoslavia, June 26–July 5, 1967. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968. 440p. (CONF-670629–(Vol.1)).

Separate abstracts were prepared for 14 of the 16 papers included. The other 2 papers have appeared previously in NSA and may be found by referring to CONF-670629 in the report number index. (J.W.R.)

For abstracts of individual papers see: 25518, 25548, 25549, 25647, 25648, 25793, 25799, 25827–25830, and 25963–25965.

25782 THREE-BODY PROBLEM WITH THE HAMADA POTENTIAL. Davies, B. (Flinders Univ., Bedford Park, South Australia). pp 563-8 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629–(Vol.2).

Detailed variational calculations were performed for the ground-state properties of helium-3 and tritium, using the Hamada–Johnston potential. An upper bound for the r-d doublet scattering length was also calculated. (J.W.R.)

25783 EFFECT OF THREE-BODY FORCES IN THE TRITON. Pask, C. (Univ. of New South Wales, Kensington, Australia). pp 569-70 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629–(Vol.2).

The contribution of three-body forces to the binding energy of the triton was calculated for the two most simple and long range three-body potentials predicted by meson theory. (J.W.R.)

25784 CONSISTENCY OF THE LOW-ENERGY 3-NUCLEON OBSERVABLES AND THE SEPARABLE INTERACTION MODEL. Phillips, A. C. (Univ. of Sussex, Brighton, Eng.). pp 571-81 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629–(Vol.2).

The separable interaction model was used to calculate the triton binding energy and the n-d doublet scattering length. Modifications are suggested which might improve the agreement with experimental data. (J.W.R.)

25785 THREE-BODY INVESTIGATIONS WITH REALISTIC POTENTIALS. Mitra, A. N. (Univ. of Delhi). pp 527-47 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629–(Vol.2).

The criteria for choosing nuclear potentials and the use of three-body systems for testing these potentials, are discussed. Some results of calculations for helium-3, tritons, trineutrons, and n–d scattering are described. (J.W.R.)

25786 BINDING ENERGY OF THE SYMMETRIC S STATE OF THE TRITON FOR VARIOUS LOCAL POTENTIALS. Noyes, H. Pierre; Osborn, T. (Stanford Linear Accelerator Center, Calif.). pp 549 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629–(Vol.2).

Assuming a symmetric S-state, the binding energy of the triton was calculated using a two-variable Faddeev equation. The calculations were performed for two separable Yamaguchi potentials, two Yukawa potentials, and two exponential potentials. The same parameters were used for all three cases. (J.W.R.)

25787 CALCULATION OF THE TRITON BINDING ENERGY. Hawkins, S. M.; Hennell, M. A.; Humberston, J. W.; Wallace, J. B. G. (University Coll., London). pp 551-6 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629–(Vol.2).

The three-nucleon problem was reformulated for phenomenological potentials, and the binding energy of the triton was calculated by the Rayleigh–Ritz variational method using the trial function of Blatt and Delves. Calculations were also performed using various mixtures of S-, P-, and D-states to determine the significance of various components of the trial function. (J.W.R.)

25788 THE d(d,n)^{3}He AND d(d,p)T REACTIONS AT ENERGIES BELOW 500 keV. Boersma, H. J. (Univ., Amsterdam). pp 503-14 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629–(Vol.2).

The (d,n) and (d,p) reactions with deuterium at energies below 500 keV were analyzed to check the energy dependence of the matrix elements. It was concluded that it is not possible to completely explain the difference in the two reaction modes. (J.W.R.)

25789 FEW BODY PROBLEMS, LIGHT NUCLEI, AND NUCLEAR INTERACTIONS. VOLUME 2. Proceedings of the Symposium held in Brela, Yugoslavia, June 26–July 5, 1967. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968. 479p. (CONF-670629–(Vol.2)).

Separate abstracts were prepared for 38 of the 42 papers included. The other 4 papers have appeared previously in NSA and may be found by referring to CONF-670629 in the report number index. (J.W.R.)

For abstracts of individual papers see: 25649–25651, 25709, 25782–25788, 25790–25792, 25794–25798, 25800–25808, 25823–25826, 25831–25835, and 25962.

25790 SPECTROSCOPY OF THE FOUR-NUCLEON SYSTEM. Meyerhof, W. E. (Stanford Univ., Calif.). pp 431-50 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629–(Vol.2).

The experimental and theoretical studies on the spectroscopy of the four-nucleon system are surveyed. The ^{4}Be, ^{4}H, ^{4}He, ^{4}Li, and tetraneutron systems are discussed. (J.W.R.)

25791 SCATTERING OF POLARIZED PROTONS BY ^{3}He. Haeberli, W.; Morrow, L. W. (Univ. of Wisconsin, Madison). pp 459-67 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629–(Vol.2).

The asymmetry in the scattering of polarized protons by ^{3}He was measured at 14 angles from 15 to 156° in the center-of-mass system, and at 5 energies from 4.0 to 10.8 MeV. A phase shift analysis was performed using the data along with earlier cross section and polarization measurements. (J.W.R.)

25792 TENTATIVE PHASE SHIFT ANALYSIS OF ^{3}He(n,n)^{3}He. Buesser, F. W.; Niebergall, F. (Univ. of Hamburg). pp 469-84 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629–(Vol.2).

A phase shift analysis was performed for cross section and polarization data on neutron elastic scattering by ^{3}He at 1 to 17.5 MeV. The resultant parameters do not yield direct information on ^{4}He states since inelastic channels were not considered. The analysis indicates inconsistencies in the experimental data available. (J.W.R.)

25793 PHENOMENOLOGY OF THE REACTION $\gamma + {}^4\text{He} \rightarrow {}^4\text{He} + \pi^0$. Bosco, B.; Ciocchetti, G. (Univ., Cagliari, Italy. Institut de Physique Nucleaire, Orsay, France). pp 415-17 of Few Body Problems, Light Nuclei, and Nuclear Interactions.

Vol. 1. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

The use of the reaction $\gamma + {}^4He \rightarrow {}^4He + \pi^0$ in studying the Brueckner effect is discussed. Discrepancies between current data and theory indicate that great care should be exercised in experiments of this kind. (J.W.R.)

25794 ELASTIC UNITARITY AND ELECTROMAGNETIC PHENOMENA IN THREE-BODY SYSTEMS. Bosco, B. (Univ., Cagliari, Italy). pp 721-7 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

Calculations were performed to determine the correction to nucleon-deuteron interaction cross sections due to transitions from the $T = \frac{1}{2}$, $S = \frac{1}{2}$ continuum states to $T = \frac{1}{2}$, $S = \frac{1}{2}$ bound states. (J.W.R.)

25795 EXPERIMENTAL STUDY OF THE REACTION $D(p,\gamma)^3He$ AT $E_p = 156$ MeV. Bachelier, D.; Bernas, M.; Brissaud, I.; Detraz, C.; Didelez, J. P.; Langevin-Joliot, H.; Lee, J.; Radvanyi, P. (Paris Univ., Orsay, France). pp 729-32 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

The differential cross section for the $D(p,\gamma)^3He$ reaction was measured at 156 MeV from 20 to 160° in the center-of-mass system. (J.W.R.)

25796 EXPERIMENTAL STUDY OF THE REACTION $T(p,\gamma)^4He$ AT $E_p = 156$ MeV. Didelez, J. P.; Langevin-Joliot, H.; Narboni, P.; Chretien, G. (Paris Univ., Orsay, France). pp 733-5 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

The differential cross section was measured from 24 to 144° for the $T(p,\gamma)^4He$ reaction at 156 MeV. (J.W.R.)

25797 ON THE THEORY OF $d(p,\gamma)^3He$ REACTION IN THE BORN APPROXIMATION. Maric, Z. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 737-45 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

The reaction $d(p,\gamma)^3He$ at 156 MeV was analyzed in the Born approximation to test the parameters of phenomenological wave functions for three body systems. The wave functions used included Gaussian, Gaussian superpositions, Irving, and Irving–Gunn radial functions. (J.W.R.)

25798 RADIATIVE p + T CAPTURE. Bijedic, N. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 747-50 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The cross section for the $T(p,\gamma)^4He$ reaction at 156 MeV was calculated in the impulse approximation using Gaussian, Irving, and Irving–Gunn wave functions. (J.W.R.)

25799 COULOMB ENERGY OF ^3He AND THE DIFFERENCE BETWEEN LOCAL AND NONLOCAL POTENTIALS. Okamoto, K.; Lucas, C. (Univ. of New South Wales, Kensington, Australia). pp 361-3 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 1. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.1).

It is suggested that a calculation for ^3He, indicating that the Coulomb energy is approximately equal to the binding energy difference, is in error due to the parameters used in the nonlocal potential. (J.W.R.)

25800 THEORY OF RADIATIVE CAPTURE OF SLOW NEUTRONS BY DEUTERONS. Phillips, A. C. (Univ. of Sussex, Brighton, Eng.). pp 759-71 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The features of radiative capture of slow neutrons by deuterons were compared with n-p capture. A three-nucleon wave function was constructed in the framework of the Faddeev method. A separable interaction model was also constructed and the S′- and D-state probabilities calculated. (J.W.R.)

25801 ELASTIC SCATTERING OF FAST NEUTRONS BY LIQUID HYDROGEN, DEUTERIUM, TRITIUM, AND BY ^3He. Seagrave, John D. (Los Alamos Scientific Lab., N. Mex.). pp 787-845 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The facilities for performing neutron physics experiments on the liquid hydrogen isotopes and ^3He at Los Alamos are described. Work currently being done and some future projects are discussed. Some preliminary data on n-d and n-t reactions are reported. The experimental data on neutron interactions with protons, deuterons, tritons, and ^3He are reviewed briefly. (137 references) (J.W.R.)

25802 NEUTRON INDUCED REACTIONS ON ^3He AT $E_n = 14.4$ MeV. Antolkovic, B. (Inst. Rudjer Boskovic, Zagreb). pp 847-52 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

The charged-particle spectra from (n,p) and (n,d) reactions with ^3He at 14.4 MeV were measured. The angular distributions and total cross sections were obtained. The ^3He recoil spectra from neutron elastic scattering were also measured up to 40° in the laboratory coordinates. The reaction mechanisms were examined. (J.W.R.)

25803 OBSERVATION OF THE NEUTRON–NEUTRON INTERACTION IN THE D(n,2n) REACTION AT 14.5 MeV BY DOUBLE TIME-OF-FLIGHT SPECTROMETER. Perrin, C.; Perrin, P.; Giorni, A.; Quivy, P.; Saltmarsh, M.; Desreumaux, S.; Bouchez, R. (Univ., Grenoble, France. CEN, Grenoble, France). pp 853-5 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The energy of the final-state neutrons from the D(n,2n) reaction at 14.5 MeV were measured using a double time-of-flight spectrometer. A $^1S_0$ n-n peak was observed. (J.W.R.)

25804 NEUTRON INDUCED REACTIONS IN TRITIUM. Debertin, K.; Roessle, E.; Schott, J. U. (Univ., Frankfurt am Main). pp 857-62 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The cross section for the T(n,p) reaction was measured at $E_n = 14$, 18, and 21.5 MeV and the value found was consistent with the nonexistence of the trineutron. The elastic scattering cross section was also measured at 14 and 18 MeV. (J.W.R.)

25805 SOME EXPERIMENTAL INDICATIONS AGAINST BOUND TRINEUTRON. Popic, R.; Stepancic, B.; Aleksic, M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 863-6 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

An attempt was made to detect bound trineutrons by the $^{28}Si(3n,\alpha)$ reaction assuming that bound trineutrons are produced in the T(n,p) reaction. The $^{28}Si(3n,\alpha)$ cross section suggests an upper limit to the T(n,p) cross section which is not consistent with earlier data supporting bound trineutrons. (J.W.R.)

25806 ELASTIC SCATTERING OF 14.4 MeV NEUTRONS ON HYDROGEN ISOTOPES. Basar, I. (Inst. Rudjer Boskovic, Zagreb). pp 867-72 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The absolute differential cross sections were measured for the elastic scattering of 14.4-MeV neutrons on protons, deuterons, and tritons. (J.W.R.)

25807 STUDIES OF p–D AND p–^3He INTERACTIONS AT ENERGIES AROUND 40 MeV. Bar-Avraham, E. (Univ. of Southern California, Los Angeles); Chang, C. C.; Forster, H. H.; (and others). pp 649-54 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

Differential cross sections for elastic p-d scattering were

measured at 35 and 46 MeV. The angular variation of proton and deuteron spectra from D(p,p)np and ^{3}He(p,d)2p reactions were measured. Proton–proton correlation spectra were taken for the D(p,2p)n reaction, and p-d correlation spectra were taken for the ^{3}He(p,pd)p reaction. Proton spectra from the ^{3}He(p,p′) reaction at 34.2 MeV were also measured to search for possible levels in ^{3}He. (J.W.R.)

25808 2D MEASUREMENTS OF THE REACTION H(d,2p)n AT 14 MeV. Kuehn, B.; Kumpf, H.; Moeller, K.; Moesner, J. (Central Inst. of Nuclear Research, Rossendorf, Ger.). pp 655-60 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The two-dimensional spectra of protons from the reaction H(p,2p) reaction were measured at 14.2 MeV. The cross section was determined and the matrix elements calculated. Theoretical matrix elements were calculated using the pole graph approximation and these were compared with the experimental spectrum. (J.W.R.)

25809 CORRECTIONS TO THE IMPULSE APPROXIMATION IN THE REACTION D(p,2p)n AT 155 MeV. L'Huillier, M. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., A129: 196-204(1969). (In French).

First and second order terms of the multiple scattering expansion for the proton–deuteron inelastic reaction are introduced in an antisymmetrized way. The impulse approximation was used to relate the first interactions to the free nucleon–nucleon scattering amplitude (from a Hamada–Johnston potential). Second order interactions were studied with a central s potential (either a square well or a separable potential); and by factorizing the $\bar{t}$ nucleon–nucleon matrices. Results were compared with measurements performed at Orsay. Agreement was good for the shape of the angular distributions. But corrections due to double scattering processes were too large. (auth)

25810 D(p,2p)n REACTION AT 155 MeV AND COMPARISON WITH THE FIRST-ORDER IMPULSE APPROXIMATION. Morlet, M.; Frascaria, R.; Geoffrion, B.; Marty, N.; Tatischeff, B.; Willis, A. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., A129: 177-95(1969).

Quasi-elastic proton–proton scattering cross sections on deuterium were measured for a large range of kinematical conditions. A comparison was made between experimental differential cross sections and theoretical values which take into account all possible double scattering effects. Such corrections to the first-order impulse approximation agree with the shape of the curves but are generally too large. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 25523, 25525, 25777, 25781, 25789, 25853, 25897, and 25950.

25811 (CEA-R-3670) CONTRIBUTION TO THE STUDY OF THE REACTION p + ^{11}B = 3α BY THE COINCIDENCE METHOD. Laugier, Jean-Philippe (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Feb. 1969. 129p. (In French). Dep.

Thesis. Submitted to Univ. of Paris, Orsay, France.

The sequential reaction p + ^{11}B → ^{12}C → α + ^{8}Be → α + α + α was studied at proton energies of 1.4 to 7.2 MeV. Information was obtained on spin effects of the ^{12}C compound nucleus, influences of the sequential decay of ^{7}Be, and on interference effects. A theoretical expression was derived for the spectrum which takes into account the observed phenomena. (J.W.R.)

25812 (JINR-P1-4373) THE FAST ^{3}He-NUCLEUS PRODUCTION ON LIGHT NUCLEI UNDER 665-MeV PROTON BEAM BOMBARDMENT. Komarov, V. I.; Kosarev, G. E.; Savchenko, O. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1969. 19p. (In Russian). Dep.

The cross sections for knocking out fast 530 MeV ^{3}He-nuclei from ^{6}Li, ^{9}Be, ^{12}C targets at 5.4° to the 665 MeV proton beam were measured. The peak in the high energy part of the ^{3}He momentum spectrum was observed which is due to the quasielastic scattering (QES) of protons on three nucleon clusters in the investigated nuclei. The cross sections of such scattering causing the ^{3}He knock-out from ^{6}Li, ^{9}Be (and the upper limit for ^{12}C, ^{16}O) were evaluated. Also the differential cross section of elastic scattering (ES) of protons on free ^{3}He nuclei (Θ = 169° cms, q = 8.8 fm^{-1}) was measured. These measurements were performed as a part of the program of experimental investigations of high-energy proton interactions with nuclei resulting in the high momentum transfer to a few nucleon system without its disintegration. QES of protons by the two nucleon clusters in light nuclei accompanied by the fast deuteron knocking out for the first time was observed in the experiments and more completely was investigated recently. QES of protons on alphaclusters in light nuclei in the conditions of the 9.5 fm^{-1} momentum transfer was observed in experiments and may be compared with p ^{4}He ES measured previously. The comparison of all mentioned data points out a simple relation: the experimental values of QES differential cross sections may be calculated to within a 1.5–2.0 factor if one suggests that the differential cross section of proton scattering on the intranuclear cluster is equal to the differential cross section of proton ES on the corresponding free nucleus (d,^{3}He,^{4}He) and the total effective number of such clusters is equal to A/m (A is atomic weight of the target nucleus, and m is the cluster nucleon quantity). This result is reasonable if the knocking-out of fast (d,^{3}He,^{4}He) from light nuclei in the investigated energy region occurred by direct interaction of the bombarding proton with intranuclear clusters and effective numbers of such clusters capable of acquiring a large momentum transfer with the same probability as the corresponding free nucleus are close to those obtained in oscillator shell calculations. From the direct nuclear reactions point of view these data confirm the idea that the main contribution to the fast nuclear fragment production with the energy in the QES peak region is given by a pole graph. The reduced vertex parts corresponding to the virtual d,^{3}He,^{4}He emittance are rather large. (auth)

25813 (ORNL-TM-2543) REPORT TO THE AEC NUCLEAR CROSS SECTION ADVISORY COMMITTEE. Stelson, P. H. (Oak Ridge National Lab., Tenn.). Mar. 1969. 16p. Dep. CFSTI.

This memo is a collection of brief reports on recent work at ORNL which is pertinent to the interests of the NCSAC. (auth)

25814 (UCRL-18774) ISOSPIN PURITY AND DECAY OF THE T = ³/₂ ANALOGUE STATE IN ^{17}F. Hardy, J. C.; Esterl, John E.; Sextro, R. G.; Cerny, Joseph (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1969. Contract W-7405-eng-48. 6p. (CONF-690310-3). Dep. CFSTI.

From Conference on Isobaric Spin, Pacific Grove, Calif.

All allowed β^+-decay branches of the $T_z = -\frac{3}{2}$ nucleus ^{17}Ne lead to states in ^{17}F which are above the proton separation energy. From the relative intensities of the emitted proton groups absolute log ft values can be determined for all significant branches, including the superallowed decay to its T = ³/₂ analogue in ^{17}F (E_x = 11.197 MeV). TiO_2 foils were bombarded with a 45-MeV ^{3}He beam and the recoils swept with helium into a well-shielded counting chamber 15 feet away in ~100 msec. Particle decays were detected in a ΔE-E counter telescope (FWHM = 40 keV) and particle-γ coincidences were observed using a NaI(Tl) detector. The analog state was observed to emit protons to the ground, first, third, and fourth excited states of ^{16}O. The log ft value for the decay branch feeding it was determined to be 3.35 ± 0.10, indicating that the isospin purity of the state is ~87%. Three states around 8 MeV have log ft values ≤4.2; one may be the missing member of a pair of states involving the "anti-analog" configuration. (auth)

25815 550- TO 1000-MeV ELECTRON QUASIELASTIC SCATTERING ON NUCLEONS OF THE ^{12}C NUCLEUS. Dementii, S. V.; Afanas'ev, N. G.; Arkatov, I. M.; Vlasenko, V. G.; Gol'dshtein, V. A.; Kuplennikov, E. L. (Physical-Technical Inst., Kharkov). Yadern. Fiz., 9: 241-53(Feb. 1969). (In Russian).

Measurements of 580, 805, and 968-MeV electron scattering are given for the scattering angle range 16 to 60° on the ^{12}C nucleus. It is shown that the position and the form of inelastic continuum is in reasonable agreement with the prediction of the theory of quasielastic electron scattering on nuclear nucleons. The fact that in spite of the general good agreement experimental cross sections turn out to be lower than calculated ones at 200 < q < 400 MeV/c, allows one to suppose that the nucleus has a larger number of nucleon states with the momenta 200 to 400 MeV/c than is predicted by the one-particle shell model. (auth)

25816 INVESTIGATION OF THE REACTION ^{11}B(γ,p). Sorokin, Yu. I.; Shevchenkov, V. G.; Yur'ev, B. A. (Moscow State Univ.). Yadern. Fiz., 9: 254-7(Feb. 1969). (In Russian).

The yield curve of the reaction ^{11}B(γ,p) in the energy region from ~15 up to 31.5 MeV was measured by means of semiconductor counters. The curve of the cross section calculated from the yield curve using the Penfold–Leiss method has manifest resonances at 21.6, 23.2, 25.5, 27.7, and 29.2 MeV and a number of less clear maxima. The integral cross section of the reaction (γ,p) up to 31 MeV is found to be 98 MeV·mbn. The results obtained are compared with the experimental data on the reaction ^{11}B(γ,n) and with the results of theoretical works. (auth)

25817 INELASTIC SCATTERING OF ^{3}He IONS ON LIGHT AND INTERMEDIATE NUCLEI. Artemov, K. P.; Gol'dberg, V. Z.; Rudakov, V. P. Yadern. Fiz., 9: 266-82(Feb. 1969). (In Russian).

Differential cross sections of inelastic scattering of ^{3}He ions with energy ~36 MeV on the nuclei of ^{12,13}C, ^{20,22}Ne, ^{27}Al, ^{28}Si, ^{52}Cr, and ^{58,60,62,64}Ni and with the energy ~27 MeV on the ^{12}C and ^{28}Si nuclei are measured. The cross sections obtained were analyzed by the distorted wave method. Deformation parameters of all the nuclei were found. A general picture of the ^{3}He inelastic scattering is like that of the α-particle scattering i.e., excitation of nuclear lower collective states prevails, the phase shift rule for the differential cross section oscillations is fulfilled. Results of the calculation by the distorted wave method is in good agreement with the experimental data. Deformation parameters obtained are close to those obtained by other methods. (auth)

25818 DIRECT AND COMPOUND-NUCLEUS NEUTRONS FROM 14 TO 18-MeV PROTONS ON ^{9}Be, ^{14}N, ^{27}Al, ^{56}Fe, ^{115}In, ^{181}Ta, and ^{208}Pb AND FROM 33-MeV BREMSSTRAHLUNG ON ^{27}Al, ^{204}Pb, ^{208}Pb, and ^{209}Bi. Verbinski, Victor V.; Burrus, Walter R. (Oak Ridge National Lab., Tenn.). Phys. Rev., 177: 1671-86(Jan. 20, 1969).

The angle-integrated experimental (p,xn) spectra, fitted with precompound and evaporation spectra from Griffin's statistical model of intermediate structure, produced g, the number of independent-particle states per MeV, and f_c, the compound fraction. For ^{27}Al, ^{56}Fe, ^{115}In, and ^{181}Ta, g increased linearly with A, from 2 to 13, but decreased to 9 ± 1 for ^{208}Pb, at 18-MeV proton energy E_p. At E_p = 14 MeV, g = 7 ± 1 for ^{208}Pb, which may signify vanishing shell effects at large E_p. Monte Carlo-type intranuclear-cascade-plus-evaporation calculations yielded spectra and cross sections in agreement with the measurements, allowing for several calculational defects that were made obvious in the comparisons. The Monte Carlo calculations yielded f_c values close to those derived by fitting the data with Griffin's calculations for targets heavier than ^{27}Al. "Nuclear temperatures," obtained from Le-Couteur's evaporation analysis for multiple-nucleon emissions, agreed for (p,xn) and giant-resonance (γ,xn) reactions, both via the intermediate nucleus ^{209}Bi, but differed considerably for the target ^{27}Al, where direct and evaporation neutrons are not well separated in mean energy. The three types of analyses utilized here are therefore much more applicable for heavy nuclei than for light. Energy and angle dependence of (γ,xn) reactions indicate negligible direct effects, in sharp contrast to (p,xn) reactions, which display a strong forward anisotropy at the high-energy end of the spectra. (auth)

25819 EFFECTIVE TWO-BODY FORCE INFERRED FROM THE (p,n) REACTION ON ^{17}O, ^{18}O, ^{27}Al, AND OTHER LIGHT NUCLEI. Anderson, J. D. (Univ. of California, Livermore); Bloom, S. D.; Wong, Calvin; Hornyak, W. F.; Madsen, V. A. Phys. Rev., 177: 1416-35(Jan. 20, 1969).

Using the Livermore variable-energy cyclotron time-of-flight facility, the angular distribution of the neutrons from the (p,n) reaction on ^{17}O, ^{18}O, and ^{27}Al was measured in 15° steps from 0 to 135° for 13 proton energies between 7 and 13.5 MeV. The persistence of a rather large ^{18}O(p,n)^{18}F ground-state reaction (ΔT = 1, ΔJ = 1) over the entire energy region studied clearly indicates the operation of a spin-flip mechanism in the effective two-body force. The ^{18}O and ^{17}O(p,n) isobaric cross sections (ΔT = 0, ΔJ = 0) are experimentally observed to be roughly equal, while optical-model calculations (including the isospin potential) predict ^{18}O cross sections to be twice as large as those for ^{17}O. This disagreement can be qualitatively explained by the presence of a large spin-flip term in the effective two-body force. The ^{17}O(p,n$_1$)^{17}F* ($J_i = {}^1/_2{}^+$, $J_f = {}^1/_2{}^+$) and the ^{18}O(p,n)^{18}F* (ΔT = 0, $J_i = 0^+$, $J_f = 2^+$) cross sections indicate a sizeable value for the quadrupole term in the multipole expansion of the effective two-body force. These data and other light-nucleus data are analyzed using the distorted-wave Born approximation to yield an estimate of the effective central two-body interaction. For an assumed Yukawa force with a range of 1.4 fm, this analysis yields $V_r \simeq 9$ MeV and $V_{er} \simeq 6$ MeV. A comparison is made between these force constants and those obtained from other sources. (auth)

25820 PION CAPTURE IN ^{6}Li AND ^{7}Li, THE FORMATION OF ^{4}H, A SEARCH FOR ^{5}H. Minehart, R. C.; Coulson, L.; Grubb III, W. F.; Ziock, K. (Univ. of Virginia, Charlottesville). Phys. Rev., 177: 1455-63(Jan. 20, 1969).

The breakup of ^{6}Li and ^{7}Li into two charged particles following π^- capture was studied. The branching ratios for the reactions π^- + ^{6}Li → 2^{3}H (3.4×10^{-4}), π^- + ^{7}Li → ^{3}H + ^{4}H (3.7×10^{-4}), and π^- + ^{7}Li → ^{3}H + ^{4}H* (4×10^{-4}) were measured. The energy of the ground state and first excited state (^{4}H*) of particle-unstable ^{4}H are found to be 2.9 and 6.1 MeV above the energy of the unbound ^{3}H + n. An upper limit is set for the branching ratio of the reaction π^- + ^{7}Li → ^{2}H + ^{5}H (<2×10^{-4}). (auth)

25821 MICROSCOPIC ANALYSIS OF THE (^{3}He,t) AND (^{3}He,^{3}He') REACTIONS ON 1p-SHELL NUCLEI. Ball, Gordon C.; Cerny, Joseph (Univ. of California, Berkeley). Phys. Rev., 177: 1466-97(Jan. 20, 1969).

The (^{3}He,t) and (^{3}He,^{3}He') reactions on ^{9}Be, ^{12}C, ^{13}C, ^{14}C [(^{3}He,t) reaction only], ^{14}N, and ^{15}N were investigated at ^{3}He energies varying between 40 and 50 MeV. Angular distributions were obtained for all prominent states up to excitations of 20 MeV. A microscopic analysis of these data has been carried out, using a local two-body interaction with an arbitrary spin-isospin exchange mixture. Spectroscopic factors were calculated, using intermediate-coupling wave functions for p-shell states, while simple j-j configurations were assumed for the levels which were populated by promoting a p nucleon to the s-d shell. A Yukawa interaction with a range of 1.2 F was found to give the best results. The strength of the effective nucleon-nucleon interaction required to fit these data is in good agreement with recent analyses of the (p,p') and (p,n) reactions on light nuclei. In particular, dominant L = 0 transitions observed in the (^{3}He,t) reaction give values for the isospin-dependent ($V_{ST} = V_{01}$) and spin-isospin-dependent (V_{11}) terms (converted to an effective nucleon-nucleon interaction at a range of 1.0 F) of 20.6 and 16.5 MeV, respectively, while the strengths required to fit (^{3}He,t) L = 2,3 transitions were generally enhanced. For inelastic transitions, the average strengths obtained for V_{00}, assuming a Serber exchange mixture, varied from 47.2 to 67.3 MeV, depending upon the L transfer involved. A comparison of the (^{3}He,t) and (^{3}He,^{3}He') reactions populating analog final states (where $T_f = T_i + 1$) is also presented. In general, these transitions were weak; however, it was possible to observe the lowest T = $^{3}/_{2}$ levels in the mirror nuclei ^{9}B–^{9}Be and ^{13}N–^{13}C, and several T = 1 levels in ^{12}N–^{12}C. (auth)

25822 BRUECKNER–HARTREE–FOCK CALCULATIONS OF SPHERICAL NUCLEI IN AN HARMONIC-OSCILLATOR BASIS. Davies, K. T. R. (Oak Ridge National Lab., Tenn.); Baranger, M.; Tarbutton, R. M.; Kuo, T. T. S. Contract Nonr-760(15) NR-024-439. Phys. Rev., 177: 1519-26(Jan. 20, 1969).

A method is developed for performing Brueckner–Hartree–Fock (BHF) calculations of spherical nuclei in the harmonic-oscillator representation. Both the Brueckner and the HF self-consistencies are satisfied. The method is applied to the calculation of ^{16}O, ^{40}Ca, ^{48}Ca, and ^{208}Pb with a G matrix derived from the Hamada–Johnston potential. The nuclei are too small and underbound. Various kinds of convergence are studied. It is concluded that the calculations are essentially as easy and as reliable as, though a little longer than, pure Hartree–Fock calculations. (auth)

25823 THREE-BODY MODEL OF ^{6}Li. Lovitch, Lionel; Rosati, Sergio (Univ., Pisa, Italy. Istituto Nazionale di Fisica Nucleare, Pisa, Italy). pp 583-9 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The alpha–proton–neutron model of ^{6}Li is discussed. The construction of the ground-state wave function is described, and the relevancy of the definition of relative angular momenta to the removal of spurious states is shown. (J.W.R.)

25824 SPECTROSCOPIC FACTORS FROM THE (p,2p) REACTIONS ON LIGHT NUCLEI. Jain, B. K.; Jackson, Daphne F. (Univ. of Surrey, London). pp 515-24 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The data on (p,2p) reactions with ^{10}B, ^{11}B, ^{12}C, and ^{6}Li at 160 to 185 MeV were analyzed using the distorted-wave impulse approximation. Spectroscopic factors were calculated for the energy levels that were resolved in the data. (J.W.R.)

25825 (n,t) REACTIONS ON SOME LIGHT NUCLEI. Rendic, D. (Inst. Rudjer Boskovic, Zagreb). pp 485-96 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The differential cross sections were measured for (n,t) reactions on ^{19}F, ^{6}Li, and ^{14}N at 14.4 MeV. The cross section for the ^{6}Li(n,t) reaction at 2.7 MeV was also measured. (J.W.R.)

25826 REACTIONS ^{6}Li + n, GOING TO T = 1 FINAL STATES IN ^{6}Li AND ^{6}He. Bass, R.; Krueger, K.; Presser, G. (Univ., Frankfurt am Main). pp 497-501 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The total cross section for the ^{6}Li(n,p)^{6}He reaction at 3 to 9 MeV was determined by measuring the β activity of ^{6}He. The total cross section for neutron inelastic scattering on ^{6}Li at 4 to 6 MeV was determined by measuring the γ yield resulting from the decay of the first excited state in ^{6}Li. (J.W.R.)

25827 ^{9}Be(^{6}He,α)^{11}Be REACTION. Stepancic, B.; Popic, R.; Aleksic, M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 419-21 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 1. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The cross section for the ^{9}Be(^{6}He,α)^{11}Be reaction was determined by measuring β and γ activities of ^{11}Be. The ^{6}He particles were produced by the ^{9}Be(n,α)^{6}He reaction. A relatively large cross section of 11 ± 4 mb was obtained indicating a direct mechanism for the reaction. (J.W.R.)

25828 THE REACTION ^{9}Be(^{6}He,α)^{11}Be IN DOUBLE STRIPPING THEORY. Zakula, R.; Maric, Z. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 423-7 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 1. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The angular distribution and cross section for the ^{9}Be(^{6}He,α)^{11}Be reaction was calculated using the plane-wave Born approximation. A stripping mechanism was assumed and harmonic oscillator wave functions were used. (J.W.R.)

25829 THE T = 0 STATES OF ^{6}Li. Haeberli, W. (Univ. of Wisconsin, Madison). pp 367-94 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 1. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The experimental and theoretical data on excited states in ^{6}Li are reviewed. Some new results on d-α scattering, including a phase shift analysis, are reported. (J.W.R.)

25830 (α,t) AND (α,^{3}He) REACTIONS ON ^{12}C. pp 395-400 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 1. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

Angular distributions were measured for (α,t) and (α,^{3}He) reactions on ^{12}C at 56 MeV. The elastic scattering cross sections were also measured. A DWBA analysis was performed assuming a stripping mechanism for the reactions. (J.W.R.)

25831 (p,t) (p,^{3}He) AND (p,d) REACTIONS ON ^{4}He AT 156 MeV AND THE FINAL STATE INTERACTION. Bernas, M.; Lee, J. K.; Bachelier, D.; Brissaud, I.; Detraz, C.; Radvanyi, P.; Roy, M. (Paris Univ., Orsay, France). pp 669-70 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The p-p and p-n final state interactions in (p,^{3}He) and (p,t) reactions on ^{4}He at 156 MeV were measured and analyzed in terms of the Watson-Migdal theory. The angular distribution of the ^{4}He(p,d) reaction was measured. (J.W.R.)

25832 A STUDY OF THE THREE-BODY REACTION ^{11}B(p,$\alpha\alpha$)α FROM 150 keV to 2 MeV. Giorni, A.; Engelhardt, D.; Cavaignac, J. F.; Longequeue, J. P.; Bouchez, R. (Univ., Grenoble, France. CEN, Grenoble, France). pp 671-86 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

Alpha spectra were measured for the three-body reaction ^{11}B(p,2α) at 0.15 to 2 MeV. Resonances corresponding to several states in ^{12}C were observed. The reaction mechanism was studied with the Dalitz plot. (J.W.R.)

25833 A STUDY OF THE LEVELS OF ^{8}Be PRODUCED BY THE REACTION ^{10}Be(d,$\alpha\alpha$)α FROM 0.6 to 2 MeV. Longequeue, J. P.; Cavaignac, J. F.; Giorni, A.; Bouchez, R. (Univ., Grenoble, France. CEN, Grenoble, France). pp 687-98 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

A multiparameter analysis was performed for the reaction ^{10}B(d,2α) at 0.6 to 2 MeV to study correlations between the α particles and states of ^{8}Be up to 17 MeV. Positions and widths of the 2^{+} and 4^{+} states in ^{8}Be were determined as well as the branching ratio for transitions to 2^{+} levels. (J.W.R.)

25834 PRELIMINARY RESULTS CONCERNING π^{-} SCATTERING ON ^{12}C IN THE RANGE 100 TO 300 MeV. Binon; Garron; Goerres; Hugon; Meunier; Spighel; Stroot; Duteil (CERN, Orsay, France). pp 783-4 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

Preliminary results on elastic and inelastic scattering of negative pions on ^{12}C at 100 to 300 MeV are reported. Results at small angles show Coulomb-nuclear interference. Evidence for the excitation of levels up to 30 MeV was found. (J.W.R.)

25835 π^{-} ABSORPTION IN ^{6}Li AND ^{12}C WITH TWO NUCLEON EMISSION. Calligaris, F.; Cernigoi, C.; Gabrielli, I. (Univ., Trieste, Italy. Istituto Nazionale di Fisica Nucleare, Trieste, Italy). pp 773-81 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The particle spectra for (π^{-},2n) and (π^{-},np) reactions on ^{6}Li and (π^{-},2n) reactions on ^{12}C were measured. (J.W.R.)

25836 TOTAL NEUTRON CROSS SECTIONS OF CARBON AND LEAD BETWEEN 5.3 AND 6.3 MeV. Yang, Chao-yie; Lin, Shih-chien; Lin, Chang-sung; Tang, Ming-dou; Ma, Peter P. Y.; Lee, Yu-hao; Chien, Ji-peng (National Tsing Hua Univ., Taiwan). Chin. J. Phys. (Taiwan), 6: 74-9(Oct. 1968).

The neutron total cross sections of carbon and lead from 5.3 to 6.3 MeV were measured by the time-of-flight technique. The background due to room scattering was almost zero. Data were corrected for in-scattering effects. A resonance was observed for carbon at 5.36 MeV. No resonances were observed for lead in this energy range. The 5.36-MeV resonance peak of carbon was analyzed by the Breit-Wigner formula. Resonance parameters were determined, and the nuclear radius is suggested. (auth)

25837 MONOPOLE EXCITATION OF DEFORMED 0^{+} STATES IN ^{16}O AND ^{40}Ca. Boeker, E. (Vrije Univ., Amsterdam). Physica, 39: 213-14(Aug. 1, 1968).

The monopole matrix elements and the transition radii for electroexcitation of the first and second excited 0^{+} states in ^{16}O and ^{40}Ca are calculated using the Brown and Green model. The calculated monopole matrix element of the 12.05-MeV state in ^{16}O is much too small. (auth)

25838 FORMATION CROSS SECTIONS OF LITHIUM, BERYLLIUM, AND BORON ISOTOPES PRODUCED BY THE SPALLATION OF OXYGEN BY HIGH-ENERGY PROTONS. Yiou, F.; Seide, C.; Bernas, R. (National Center for Scientific Research, Orsay, France). J. Geophys. Res., 74: 2447-8(May 1, 1969).

Absolute cross sections and isotopic ratios for the production of beryllium, boron, and lithium isotopes in proton spallation of oxygen at proton energies of 0.135, 0.600, and 19 GeV are presented. (D.C.W.)

25839 STUDY OF STATES IN ^{16}O BY THE REACTION ^{15}N(τ,d) ^{16}O. Bohne, W.; Homeyer, H.; Lettau, H.; Morgenstern, H.; Scheer, J.; Sichelschmidt, F. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nucl. Phys., A128: 537-44(1969).

Angular distributions of deuterons emitted in the reaction ^{15}N(τ, d)^{16}O at E_{τ} = 11 MeV were measured for transitions to 18 states. DWBA fits were made and spectroscopic factors extracted, where possible. The results are in many cases in agreement with recent theoretical predictions; some discrepancies are discussed. Also the angular distribution of tritons from the reaction ^{15}N(τ,t$_{0}$)^{15}O was measured. (auth)

25840 TOTAL PHOTONUCLEAR CROSS SECTIONS FOR ^{12}C, ^{14}N, ^{16}O, AND ^{19}F IN THE REGION OF THE GIANT RESONANCE. Bezic, N.; Brajnik, D.; Jamnik, D.; Kernel, G. (Inst. Josef Stefan, Ljubljana, Yugoslavia. Univ. of Ljubljana, Yugoslavia). Nucl. Phys., A128: 426-32(1969).

Total absorption of γ rays in the energy region 9 to 31 MeV was measured in thick absorbers of carbon, nitrogen, oxygen and fluorine by means of a Compton spectrometer. Results for the nuclear part of the absorption cross section are presented. (auth)

25841 ISOBARIC ANALOGUE STATES OF ^{10}Be–^{10}B. Roush, M. L.; Young, F. C.; Forsyth, P. D.; Hornyak, W. F. (Univ. of Maryland, College Park). Nucl. Phys., A128: 401-25(1969).

A study was made of the 5.96 and 6.26 MeV levels of ^{10}Be. Electromagnetic transitions following the ^{9}Be(d,p)^{10}Be reaction were examined. Spectra in coincidence with the proton groups were analyzed to determine γ-ray branching ratios. The result of a $\gamma-\gamma$ correlation measurement upon the cascade γ-rays from both states was consistent with J = 2 for both states. The correlation observed for the decay of the 5.96 MeV state is not consistent with that of a 1^- state. However, it is suggested that a 1^--2^+ doublet exists at 5.96 MeV in ^{10}Be with the J = 2 member decaying predominately by cascade through the 3.37 MeV state; and the J = 1 member decaying predominately by a direct ground state transition. Experimental confirmation of the doublet structure at 5.96 MeV was obtained and a level separation of 1.6 ± 0.5 keV determined with the 2^+ level being lower in excitation. Proton angular distributions at 2.8 MeV deuteron energy were determined for the individual members of the doublet to establish the parities of the states. Spectroscopic factors and reduced widths for the individual members of the doublet were extracted from plane-wave and distorted-wave analyses of the angular distributions. (auth)

25842 CHARGE EXCHANGE PION SCATTERING BY ^{13}C. Bakke, F. H.; Reitan, A. (Institutt for Teoretisk Fysikk, Trondheim, Norway). Nucl. Phys., B10: 43-7(1969).

The cross section for the reaction $^{13}C(\pi^+,\pi^0)^{13}N$ is computed for the region around the first resonance in the pion-nucleon system. The calculations are based upon the dispersion methods developed by Shapiro and collaborators. (auth)

25843 EFFECT OF TRUNCATION ON THE PROJECTED HARTREE–FOCK SPECTRA. Gunye, M. R. (McMaster Univ., Hamilton, Ont.). Nucl. Phys., A128: 457-64(1969).

The effect of the truncation of basis states on the projected Hartree–Fock spectra of 2s–1d shell nuclei is investigated. An attempt is also made to determine the effect of the strength of the effective interaction on the projected spectra by arbitrarily increasing the triplet reduced matrix elements to fit the binding energies of the nuclei considered. It is found that there is a substantial effect of the truncation of basis states on the energy spectra and electromagnetic properties of the projected states. The effect of the strength of the nuclear interaction does not seem to be as important as that of the truncation of basis states. (auth)

25844 QUARTIC ISOBARIC MULTIPLET MASS EQUATION. Jaenecke, Joachim (Univ. of Michigan, Ann Arbor). Nucl. Phys., A128: 632-40(1969).

The quadratic isobaric multiplet mass equation must be replaced by an expression which is quartic in T_z if the electrostatic interaction is treated in second-order perturbation theory. The coefficients of the cubic and quartic terms as well as the corrections to the constant, linear and quadratic terms are related to the off-diagonal reduced Coulomb matrix elements. A numerical analysis of the experimental Coulomb displacement energies in the 1p and 1d2s shell in terms of Hecht's (first-order) Coulomb energy equations showed systematic deviations for the $T = \frac{1}{2}$ multiplets, which were attributed to higher-order perturbations. For the A = 9 quadruplet the major perturbations appear to result from a lower-lying $T = \frac{1}{2}$ state (or states) which increases the excitation energies of the $T = \frac{3}{2}$ states in ^{9}B and ^{9}Be by about 105 and 93 keV, respectively, while the energies of ^{9}C and ^{9}Li are essentially unaffected. The constant and linear terms are changed very little, but the quadratic term is decreased by about 15%. Small cubic and quartic terms are generated. It is concluded that the quadratic isobaric multiplet mass equation often works well, not because first-order perturbation theory is a good approximation, but because higher-order perturbations are mostly absorbed by the three coefficients. Particularly the coefficient of the quadratic term may be affected considerably. (auth)

25845 GAMOW–TELLER β DECAYS AND M1 γ RAYS IN A = 4N + 2 NUCLEI. Kavanagh, R. W. (California Inst. of Tech., Pasadena. Institut de Recherches Nucleaires, Strasbourg). Nucl. Phys., A129: 172-6(1969).

Recent measurements of Gamow–Teller β-transitions for the A = 4N + 2 series of nuclei up to A = 30 are summarized and compared in strength to the analogous M1 γ-rays in the $T_z = 0$ nuclei. An approximate sum rule for the Gamow–Teller strengths is proposed and compared with the data. (auth)

25846 MUON CAPTURE AND NUCLEAR STRUCTURE. Fujii, Akihiko (Sophia Univ., Tokyo); Morita, Masato; Ohtsubo, Hisao. Progr. Theor. Phys. (Kyoto), Suppl. Extra No., 303-36 (1968).

A study was made of the fundamental muon-nucleon interaction from the muon capture in gaseous and molecular hydrogen and the nuclear structure problem upon the knowledge of the former from muon captures in ^{12}C and ^{16}O. The phenomenological V–A theory of leptonic interactions is adopted for the fundamental process $\mu^- + p \rightarrow n + \nu_\mu$. The behavior of the form factors is determined under the assumptions of (1) conserved vector current, (2) isotriplet vector current, (3) partially conserved axial vector current, (4) definite G-parity for the current, and (5) muon-electron universality. Calculated muon capture rates are in agreement with the recent data on gaseous hydrogen, and also with the data on molecular hydrogen if the molecular factor $2\gamma = 1.00$ is accepted. The muon capture rate is calculated for the reaction $\mu^- + {}^{12}C \rightarrow {}^{12}B$ (ground state) + ν_μ, with general p-shell wave functions which were obtained by considering the dynamical properties in the A = 12 system. The experimental ft value of the beta decay of ^{12}B, which in all previous theories is used to normalize the muon capture rate, has not been adopted in this analysis. An excellent fit to the experimental data for the capture rate as well as for the ft value has been obtained with the ^{12}B wave function proposed by Kurath to explain the magnetic moment of ^{12}B and a ^{12}C wave function introduced here. The oscillator strength parameter is chosen to be b = 1.64 fm; this is in conformity with the elastic and most of the inelastic electron scattering data. The muon capture rates are also calculated for the reactions $\mu^- + {}^{16}O \rightarrow {}^{16}N(0^-,1^-,2^-) + \nu_\mu$, with the RPA and Tamm–Dancoff models. The calculated capture rates agree well with experimental data, if (1) $C_p/C_A = 5$ to 14 and the Gillet wave functions are adopted in the reaction $0^+ \rightarrow 0^-$, (2) a configuration mixing is taken into account in the reaction $0^+ \rightarrow 1^-$, and (3) a normalization by the experimental beta decay rate of ^{16}N is introduced in the reaction $0^+ \rightarrow 2^-$. (auth)

25847 NUCLEAR HEAVY-ION–HEAVY-ION COLLISIONS AND THE INTERMEDIATE-STATE MODEL. Rickertsen, L. (Yale Univ., New Haven); Block, B.; Clark, John W.; Malik, F. B. Phys. Rev. Lett., 22: 951-5(May 5, 1969).

Five excitation functions from 50 to 90° (cm system) for ^{16}O–^{16}O elastic scattering can be accounted for by a nuclear molecular potential. The parameters of this potential are estimated from the two-nucleon potential in a model of the transient nuclear matter state. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 89

Refer also to abstracts 25523, 25805, 25813, 25817–25819, 25822, 25837, 25845, 25901, 25919, 25952, and 25972.

25848 (CEA-R-3595) STUDY OF TRANSFER REACTIONS (α,t), $(\alpha,^3He)$ IN THE f-p SHELL: MECHANISM AND SPECTROSCOPIC USE. Roussel, Pierre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1968. 152p. (In French). Dep.

Thesis. Submitted to Univ. of Paris, Orsay, France.

An experimental study was made of (α,t) and $(\alpha,^3He)$ reactions at 44 MeV using a solid-state identifier, on the target nuclei ^{54}Fe and ^{58,60,62,64}Ni. A critical study of the optical model and of distorted wave analysis was performed. The complementarity of different transfer reactions, the ambiguity of spectroscopic factors, and the importance of the problem of the reaction mechanism are shown. (auth)

25849 (CEA-R-3659) CONTRIBUTION TO THE STUDY OF β-DISINTEGRATION AND OF NUCLEAR STRUCTURE USING EXPERIMENTS ON CERTAIN $\beta-\gamma$ CASCADES: ^{198}Au, ^{86}Rb, ^{170}Tm. Lachkar, Jean (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Jan. 1969. 92p. (In French). Dep.

Thesis. Submitted to Univ. of Paris, France.

Beta–gamma directional angular correlations and shapes of inner beta spectra leading to the first excited level of the final nucleus enable one to determine the nuclear matrix elements typical of the β transition. In the three observed first-forbidden cases: ^{170}Tm, ^{86}Rb, ^{198}Au, these matrix elements do not confirm the independent shell model theory. Other hypotheses are then suggested and discussed. (auth)

25850 (CONF-690310-4) A MULTI-EXIT CHANNEL STUDY OF ANALOG RESONANCES IN THE ^{51}V + p REACTION. Coleman, H.; Divadeenam, M. (Duke Univ., Durham, N. C.); McEver,

W.; Joyce, J. M.; Ludwig, E. J.; Shafroth, S. M. (North Carolina Univ., Chapel Hill. Triangle Universities Nuclear Lab., Durham, N. C.). [1969]. 7p. Dep. CFSTI.

From Conference on Isobaric Spin, Pacific Grove, Calif.

Excitation curves were obtained over the proton energy range of 2.15 to 3.15 MeV for γ rays and ground-state neutrons arising from the $^{51}V(p,p'\gamma)$, $^{51}V(p,n\gamma)$ and $^{51}V(p,n_0)$ reactions. Targets were ≈10 keV thick. Gamma rays were detected with a 20 cc Ge(Li) detector. Only effects which occurred in several exit channels simultaneously were assumed to be intermediate resonances. If they also occur at excitation energies in ^{52}Cr corresponding to known levels in ^{52}V they were considered to be analog resonances. Seventeen γ-ray angular distribution measurements were made at most of the analog resonance energies. These measurements, when compared with theory, together with the presence of resonances in certain exit channels leads to spin-parity assignments for resonances in ^{52}Cr and levels in ^{52}V. (auth)

25851 (JINR–P3-4357) PARAMETERS OF THE NEUTRON RESONANCES OF THE ^{85}Rb AND ^{87}Rb ISOTOPES. Grebenyuk, M. K.; Kovach, P. Sh.; Malecki, H.; Salamatin, I. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1969. 11p. (In Russian). Dep.

Transmission and neutron radiative capture measurements were performed on enriched ^{85}Rb and ^{87}Rb isotopes by the time-of-flight method in the pulsed fast reactor IBR. The parameters of 54 isolated resonances were obtained in the neutron energy range up to ≈20 keV. For both isotopes the values of strength functions are found to be $1.1^{+}_{0}:\frac{4}{5}$ (^{85}Rb) and $1.6^{+}_{0}:\frac{4}{7}$ (^{87}Rb). (auth)

25852 (LNF-68/66) DOUBLE π^- PHOTOPRODUCTION ON MEDIUM WEIGHT NUCLEI. Note No. 418. Belli, B. M.; Di Napoli, V.; Laitano, F.; Margadonna, D.; Picchi, P.; Salvetti, F.; Visentin, R. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Nov. 18, 1968. 13p. Dep.

Theory of double π^- photoproduction is discussed and some experimental results are presented for the $^{55}Mn(\gamma,2\pi^-)^{55}Co$ reaction at 260 and 850 MeV. (J.W.R.)

25853 (UCRL–18716) THE (p,t) AND (p,^{3}He) REACTIONS ON (2s-1d) SHELL NUCLEI. Brunnader, Heinz (California Univ., Berkeley. Lawrence Radiation Lab.). Jan. 1969. Contract W-7405-eng-48. 172p. Dep. CFSTI.

Thesis.

The excitations of high isospin (T = 2) analogue states in the $T_z = 0$ and the $T_z = +1$ A = 4n nuclei were measured for the entire (sd) shell using the (p,t) and (p,^{3}He) reactions induced by 45-MeV protons. Also, the reactions $^{40}Ar(p,t)^{38}Ar$ and $^{40}Ar(p,^3He)^{38}Cl$ were utilized to observe the first T = 3 analogue states in the $T_z = 1$ and $T_z = 2$ nuclei. In addition to these high T states, a number of T = 1 analogue states were also observed. The ratio of the observed cross sections for these T = 1 analogue states was compared with the ratio predicted from the DWBA cross section expressions. This predicted ratio is found to depend on the type of transition by which the final analogue states are formed, and hence may be used to provide structural information on the analogues without the use of detailed wave functions. The (p,t) reaction was further utilized to extend the range of known excitations in the nuclei ^{18}Ne and ^{34}Ar. All Coulomb displacement data in the (1p) and ($1d_{\frac{5}{2}}$) shells, including those derived from this work, were fitted to parameterized Coulomb displacement energy formulae derived to jj-coupling low seniority and Wigner supermultiplet schemes. The results were used to predict the masses of yet unmeasured neutron deficient nuclei in this region. (auth)

25854 CROSS SECTIONS AND MECHANISM OF (n,p) REACTIONS ON Se ISOTOPES AT THE NEUTRON ENERGY 14.7 MeV. Ivanenko, V. V.; Petrzhak, K. A. Yadern. Fiz., 9: 258-60(Feb. 1969). (In Russian).

Cross sections of the reactions $^{74}Se(n,p)$, $^{78}Se(n,p)$, $^{78}Se(n,\alpha)$, $^{74}Se(n,2n)^{73m}Se$ and the summary cross section of the reactions $^{82}Se(n,2n)$ and $^{80}Se(n,\gamma)^{81m}Se$ were measured at the neutron energy 14.7 MeV and were found to be, respectively, 148 ± 17, 21 ± 6, 38 ± 16, 420 ± 44, and 1870 ± 250 mbarn. Proton angular distributions from the (n,p) reactions were analyzed. An agreement of the experimental quantities with the results of calculations performed using the Brown–Muirheed theory indicates a fast increase of contribution from the direct interaction processes when neutron-excess nuclei are taken under consideration. (auth)

25855 STUDY OF THE STRUCTURE OF ^{28}Al NUCLEUS LEVEL BY MEANS OF THE STRIPPING REACTION $^{27}Al(d,p)^{28}Al$. Litvin, V. F.; Nemilov, Yu. A.; Zherebtsova, K. I.; Orlova, T. V.; Lakomkin, Yu. A.; Gridnev, K. A.; Krasnov, L. V. (Leningrad State Univ.). Yadern. Fiz., 9: 261-5(Feb. 1969). (In Russian).

The stripping reaction $^{27}Al(d,p)^{28}Al$ at $E_d = 2.6$ MeV was studied. A number of new excitation levels of the final nucleus ^{28}Al were obtained. Possible existence of one-particle levels with the core in excited state 0^+ is discussed. (auth)

25856 ON DETERMINATION OF MIXTURE PARAMETERS OF ROTATIONAL STATES FROM HIGH ENERGY ELECTRON SCATTERING. Tishchenko, B. I.; Inopin, E. V. (Physical-Technical Inst., Kharkov). Yadern. Fiz., 9: 346-8(Feb. 1969). (In Russian).

It is shown how to extract information about the mixture coefficients for the rotational states with various values of the K projection of the momentum I to the nucleus symmetry axis from the experimental data on elastic and inelastic electron scattering with excitation of rotational states of the nucleus. From the experiments on 225-MeV electron scattering on ^{23}Na, the coefficient of mixture of two states with $I = \frac{5}{2}$ and $K = \frac{3}{2}$, $K = \frac{5}{2}$ (states 0.44 and 2.40 MeV of ^{23}Na nucleus) was obtained: $|\alpha| = 0.88$. This value is in reasonable agreement with the quantity obtained analyzing the scheme of levels of ^{23}Na on basis of the generalized model. (auth)

25857 COULOMB EXCITATION OF NUCLEAR LEVELS ^{53}Cr, ^{57}F, ^{59}Co, ^{61}Ni, ^{91}Zr, ^{92}Zr, ^{94}Zr, ^{111}Cd, ^{121}Sb, ^{123}Sb, AND ^{123}Te. Gal'perin, L. N.; Il'yasov, A. Z.; Lemberg, I. Kh.; Firsanov, G. A. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 9: 225-40(Feb. 1969). (In Russian).

Coulomb excitation of the nuclei ^{53}Cr, ^{57}Fe, ^{59}Co, ^{61}Ni, ^{91}Zr, ^{92}Zr, ^{94}Zr, ^{111}Cd, ^{121}Sb, ^{123}Sb, and ^{123}Te was studied by means of a 3.0 cm^3 Ge(Li) detector. Targets enriched by corresponding isotopes were used. N and C ions with the energies from 31 up to 46 MeV and α particles with the energy 12 MeV were bombarding particles. The values of reduced probability of electric quadrupole transitions B(E2) and the values τ(E2) for 41 levels in 11 nuclei were determined. The values B(E2) for 13 levels were obtained for the first time. (auth)

25858 TO THE ESTIMATE OF BACKGROUND EVENTS IN EXPERIMENTS ON INVESTIGATION OF DOUBLE β DECAY OF ^{48}Ca. Pomanskii, A. A.; Severnyi, S. A.; Trifonova, E. P. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 9: 382-4(Feb. 1969). (In Russian).

2.3×10^{-15} g of ^{226}Ra was identified in 1 g of CaF_2 by means of the precision radiochemical method and with a low-background proportional counter. Possible background in experiments on the double β decay of ^{48}Ca was analyzed, as the events observed in these experiments may be due to the $\beta\gamma$ correlation arising in the decay of ^{214}Bi that is in equilibrium with ^{226}Ra. (auth)

25859 ANALYSIS OF THE T < STATES IN ^{55}Co. Vourvopoulous, G. (Florida A and M Univ., Tallahassee. Florida State Univ., Tallahassee); Fox, J. D.; Rosner, B. Phys. Rev., 177: 1789-91(Jan. 20, 1969).

Previous data from the $^{54}Fe(^3He,d)^{56}Co$ reaction are reanalyzed. Deuteron groups corresponding to low-lying states in ^{55}Co and having $l_p = 1$ are identified as T < states and their existence is explained. States at 3.327 and 4.185-MeV excitation in ^{55}Co are analyzed and found to contain a large percentage of the missing $l_p = 3$ strength of the T < states. Spectroscopic factors are extracted, and the strength of the isobaric spin-dependent potential is calculated. (auth)

25860 PHOTONEUTRON CROSS SECTIONS FOR ^{75}As, ^{107}Ag, AND ^{133}Cs. Berman, B. L.; Bramblett, R. L.; Caldwell, J. T.; Davis, H. S.; Kelly, M. A.; Fultz, S. C. (Univ. of California, Livermore). Phys. Rev., 177: 1745-54(Jan. 20, 1969).

Photoneutron cross sections, including $\sigma[(\gamma,n) + (\gamma,p,n)]$ and $\sigma(\gamma,2n)$ for ^{75}As, ^{107}Ag, and ^{133}Cs, and $\sigma(\gamma,3n)$ for ^{133}Cs, were measured as a function of photon energy from threshold to 30 MeV. The photon energy resolution varied from less than 300 keV at the lowest to 400 keV at the highest energies. The source of radiation was the monoenergetic photon beam obtained from the annihilation in flight of fast positrons. The data were taken at 300-keV intervals. The partial cross sections were determined by neutron-multiplicity counting, and the average neutron energies for both single- and double-photoneutron events were determined simultaneously with the cross-section data by the ring-ratio technique. Nuclear information extracted from the data includes giant-resonance parameters, integrated cross sections and their moments, symmetry energies, quadrupole moments, and level densities. The mass of ^{105}Ag was determined from the ^{107}Ag $(\gamma,2n)$ threshold energy. No marked structure was observed in the total photoneutron cross sections, although small deviations from a smooth curve are present, both in and above the giant resonance. (auth)

25861 SHAPE AND COMPOUND ELASTIC SCATTERING OF α PARTICLES BY ^{46}Ca, 5.0 TO 12.5 MeV. John, Joseph; Robinson, C. P.; Aldridge, J. P.; Davis, R. H. (Florida State Univ., Tallahassee). Phys. Rev., 177: 1755-62(Jan. 20, 1969).

The differential cross section for the elastic scattering of α particles by ^{40}Ca was measured at sixteen angles between 5.0 and 12.5 MeV in 10-keV intervals. Complicated structure is seen in the excitation functions which is often as fine as the experimental resolution (<10 keV). There are many closely spaced anomalies which are substantially wider than the experimental resolution. Very broad undulations are apparent in averaged differential cross-section curves for which the averaging interval is about 0.5 MeV. The averaged data are analyzed in this work. Shape elastic scattering represented by an optical model where reaction channels are either closed or strongly inhibited does not satisfactorily describe the angular distributions at the back angles. A combination of shape and compound elastic scattering reproduces the data except at the highest energies, where reaction cross sections are becoming significant. The expression for the compound elastic contribution to the cross section is based on Hauser–Feshbach theory and statistical-model considerations. Values obtained for the real potential-well depth of the optical model (~140 MeV) are consistent with results previously obtained at higher energies for the same number of nodes in the s-wave function. (auth)

25862 HIGH-RESOLUTION STUDIES OF $^{57}Fe(d,t)^{56}Fe$ AT 11.7 AND 14.5 MeV. Daehnick, W. W. (Univ. of Pittsburgh). Phys. Rev., 177: 1763-75(Jan. 20, 1969).

The $^{57}Fe(d,t)^{56}Fe$ reaction was studied at deuteron energies of 11.7 and 14.5 MeV with 6–8-keV resolution. The experimental procedures used to obtain high resolution and good particle discrimination are described. Angular distributions were obtained over the range $14° \leq \theta \leq 50°$, and l values and spectroscopic factors were extracted from comparison with distorted-wave Born-approximation (DWBA) calculations. A number of l = 3 transitions showed j-dependent effects, which were used to single out the most likely J^π assignments for poorly known states between 4- and 5-MeV excitation. For states below 4 MeV, good agreement was found with energy and J^π assignments in the recent literature. A comparison of the (d,t) spectroscopic factors with recent shell-model calculations showed qualitative agreement for strong transitions, but also proved that the assumption of an inert ^{48}Ca core is too restrictive for calculations of the Fe isotopes. (auth)

25863 PROJECTED HARTREE–FOCK SPECTRUM OF ^{28}Si INCLUDING EFFECTS OF PAIRING AND SHAPE MIXING. Tewari, S. N.; Grillot, D. (Univ. of Oregon, Eugene). Phys. Rev., 177: 1717-24(Jan. 20, 1969).

The energy spectrum of ^{28}Si was calculated using the angular-momentum states projected from the oblate and the prolate Hartree–Fock solutions. The Hartree–Fock solutions chosen take into account all 28 nucleons, and therefore the effect of the polarization of the ^{16}O core was incorporated into our calculations to some extent. The complexity of the projection calculation has been greatly simplified by suitably using the known symmetries of the Hartree–Fock solutions. The theoretically predicted energy spectrum is compressed by about a factor of 2 when compared with experiment. The small energy gap between the oblate and the prolate Hartree–Fock solutions suggested the possibility of admixing the two solutions by the two-body interaction. The two solutions differ in the four-particle–four-hole states in the intrinsic frame, and therefore the admixture was calculated in the projected basis. The mixing, however, turns out to be too small to affect the spectrum. Another attempt to improve the results was made by including the corrections due to the T = 1 pairing in the Hartree–Fock solutions, and then calculating the energy spectrum using the states projected from the corrected intrinsic states. The corrections due to the T = 1 pairing turn out to be of the order of 2% for both the oblate and the prolate Hartree–Fock solutions. This result is consistent with the earlier Hartree–Fock–Bogolyubov calculations on ^{28}Si, which predict no pairing effects. Because of the small size of the pairing corrections, the projected energy spectrum from the corrected intrinsic states does not show any significant improvement. (auth)

25864 LIFETIMES AND BRANCHING RATIOS IN ^{42}Ca EMPLOYING THE $(p,p'\gamma)$ REACTION. Kossler, W. J. (Massachusetts Inst. of Tech, Cambridge); Winkler, J.; Kavaloski, C. D. Contract AT(30-1)-2098. Phys. Rev., 177: 1725-36(Jan. 20, 1969).

The $(p,p'\gamma)$ reaction was used to study ^{42}Ca. Back-scattered protons were detected in an annular solid-state detector of 0.8-sr solid angle. The γ rays were detected in a 32-cc Ge(Li) detector placed at 55° and 125° with respect to the beam. By the Doppler-shift attenuation method (DSAM) the lifetimes of states in ^{42}Ca with the following energies were measured: 2.422 MeV [0.30 (+0.04, −0.03) psec]; 2.750 MeV [3.4(+11, −0.17) psec]; 3.250 MeV [0.3(+0.15, −0.10) psec]; 3.297 MeV [3.4(+∞, −2.1) psec]; 3.389 MeV (0.325 ± 0.075 psec); 3.442 MeV [1.35(+1.3, −1) psec]; and 3.651 MeV [0.06(±0.08, −0.06) psec]. The 1.523-MeV 2^+ state was measured to have a lifetime in close agreement with the known lifetimes. The Doppler shift on the 4.43-MeV state in ^{12}C was also measured. Branching ratios are reported for 14 states. The reduced matrix elements $B(\sigma\lambda)$ are given from 26 transitions. On the basis of branching-ratio information, $B(\sigma\lambda)$, and previously existing information, spin and parity inferences were made for the following states: 3.250 MeV (4^+); 3.297 MeV (2^+, 1^-); 3.883 MeV (1^-, 2^+); and 4.043 MeV (2^+, 3^-, 4^+). For other states, we support recent assignments from (t,p) data. Our transition rates for the 2.422-MeV (2^+), 2.750-MeV (4^+), and 3.250-MeV (4^+) states show strong enhancement over single-particle rates. These results, together with the known enhanced rates for the 1.523-MeV (2^+) and 1.836-MeV (0^+) states, strongly support the interpretation of the low-lying levels in ^{42}Ca as mixtures of a rotational band and simple shell-model configurations. The level at 3.250 MeV, (4^+) fits naturally into this scheme. (auth)

25865 STUDIES ON THE DECAY OF ^{67}Ge. Bakhru, H.; Ladenbauer-Bellis, I. M. (Yale Univ., New Haven). Phys. Rev., 177: 1686-94(Jan. 20, 1969).

The excited levels of ^{67}Ga were investigated from the decay of ^{67}Ge with Ge(Li), Si(Li), and standard scintillation counters. γ rays of the following energies were observed: 166.5, 360, 558, 576, 661, 710, 720, 728, 828, 900, 915, 981, 1082, 1116, 1283, 1450, 1677, 1509, 1644, 1810, 1837, 2004, 2100, 2170, 2210, 2510, 2559, 2726, 2958, 2991, 3065, and 3157 keV. The half-life of ^{67}Ge was measured to be 19 ± 0.3 min. With the help of γ-γ coincidence studies, a consistent level scheme of ^{67}Ga at 166.5, 333, 828, 1082, 1450, 1810, 2170, 2726, 3157, and 3398 keV has been obtained. Three major positron groups with end-point energies of 3.18 MeV (65%), 2.5 MeV (~25%), and 1.54 MeV (<10%) have been assigned to the decay of ^{67}Ge. Each group probably consists of more than one component. The results including spin and parity assignments of some of the excited levels of ^{67}Ga are discussed. The half-life of the 166-keV level is measured by delayed coincidence to be less than $(0.22 \pm 0.05) \times 10^{-9}$ sec. (auth)

25866 STUDY OF THE $^{48}Ca(^3He,p)^{50}Sc$ REACTION. Ohnuma, H. (Argonne National Lab., Ill.); Erskine, J. R.; Nolen, J. A. Jr.; Schiffer, J. P.; Roos, P. G. (Phys. Rev., 177: 1695-8 (Jan. 20, 1969).

The $^{48}Ca(^3He,p)^{50}Sc$ reaction was studied with a magnetic spectrograph at a bombarding energy of 12 MeV. Energy levels of ^{50}Sc were obtained. Spins and parities for these levels were assigned on the basis of a comparison between the experimental and calculated angular distributions. Distorted-wave Born approximation theory and the shell-model wave functions due to Kuo and Brown were used to calculate the angular distributions. (auth)

25867 LEVEL STRUCTURE OF ^{88}Zr STUDIES WITH THE $^{90}Zr(p,t)$ REACTION. Ball, J. B. (Oak Ridge National Lab., Tenn.); Auble, R. L.; Drisko, R. M.; Roos, P. G. Phys. Rev., 177: 1699-1705(Jan. 20, 1969).

The $^{90}Zr(p,t)$ reaction was used to investigate the level structure of ^{88}Zr. The experiment was performed with 31-MeV protons from Oak Ridge Isochronous Cyclotron. The tritons were analyzed with a broad-range magnetic spectrograph, and the over-all energy resolution was of the order of 20 keV. Angular distributions were obtained and spin-parity assignments were made on the basis of comparison with distorted-wave calculations. Levels in ^{88}Zr up to about 3.5 MeV in excitation have been analyzed. Comparisons are made with previously reported γ-ray energies. Spectroscopic factors extracted from the distorted-wave analysis were obtained, and provide information on the shell-model structure of the observed levels. (auth)

25868 BRANCHING RATIO OF THE γ RAYS FROM THE 184.6-keV STATE IN ^{67}Zn. Li-Scholz, Angela; Bakhru, H. (Yale Univ., New Haven). Phys. Rev., 177: 1629-30(Jan. 20, 1969).

Using a high-resolution photon spectrometer, the relative intensity of the 91.3- and 93.3-keV γ rays from the decay of ^{67}Ga was measured as $I_\gamma(91.3)/I_\gamma(93.3) = (8.5 \pm 0.8)\%$. From this result, the branching ratio of the transitions depopulating the 184.6-keV state of ^{67}Zn was deduced as $I(91.3)/I(184.6) = 3.5/24.2$. The internal conversion coefficients for the nearly pure M1 91.3-keV transition are given. Several apparent discrepancies in the literature are discussed. (auth)

25869 ANOMALOUS $5/2^+$ STATES IN ^{77}Se FROM THE DECAY OF 56-h ^{77}Br. Sarantites, D. G.; Erdal, B. R. (Washington Univ., St. Louis). Contracts AT(11-1)-1530; AT(11-1)-1162; AT(11-1)-1760. Phys. Rev., 177: 1631-40(Jan. 20, 1969).

The levels in ^{77}Se from the decay of 56-h ^{77}Br were investigated. From singles measurements of the γ-ray energies and intensities employing a high resolution Ge(Li) detector, and from coincidence relations determined in γ–γ coincidence measurements using two Ge(Li) detectors, it was established that levels at 161.9, 238.9, 249.7, 301.1, 439.5, 520.7, 581.2, 682.3, 752.2, 818.2, 824.8, 911.9, 1005.6, and 1187.5 keV are populated in the decay of 56-h ^{77}Br.

From present logft values and K-shell conversion coefficients, and from previously reported (d,p) and (d,t) reaction data, many J^π values were assigned. The level structure of the anomalous $9/2^+$ and $7/2^+$ states is compared with recent calculations on the pairing-plus-quadrupole model extended to include higher shell-model orbits, with satisfactory qualitative agreement between experiment and theory. (auth)

25870 DECAY SCHEMES OF ^{60}Zn AND ^{62}Zn. Hoffman, E. J.; Sarantites, D. G. (Washington Univ., St. Louis). Contracts AT(11-1)-1530; AT(11-1)-1760. Phys. Rev., 177: 1640-7(Jan. 20, 1969).

The decays of 2.4-min ^{60}Zn and 9.3-h ^{62}Zn were investigated with the use of Ge(Li) and NaI(Tl) γ-ray detectors. Coincidence relations among the γ rays were determined in $\gamma-\gamma$ coincidence experiments. It was established that the decay of 2.4-min ^{60}Zn populates levels at 61.4, 334.4, 364.6, 572.4, and 669.7 keV in ^{60}Cu, and the decay of 9.3-h ^{62}Zn populates levels at 40.84, 243.43, 287.86, 548.25, and 637.20 keV in ^{62}Cu. Many spin assignments were made from present logft values, previously reported conversion-electron data, and spectroscopic studies from nuclear reactions. The half-life of ^{60}Zn was measured to be 2.42 ± 0.02 min. The fraction of β decay (positron plus electron capture) of ^{62}Zn to the ground state of ^{62}Cu was measured to be 0.43 ± 0.05; the ratio of positron to K capture for the same decay was measured to be 0.22 ± 0.01. (auth)

25871 DECAY SCHEME OF THE 86-SEC ^{61}Zn. Hoffman, E. J.; Sarantites, D. G. (Washington Univ., St. Louis). Contracts AT(11-1)-1530; AT(11-1)-1760. Phys. Rev., 177: 1647-55(Jan. 20, 1969).

The decay of the 86-sec ^{61}Zn was investigated using Ge(Li) and NaI(Tl) γ-ray detectors. Coincidence relations among the γ rays were established in $\gamma-\gamma$ coincidence experiments. It was found from observed coincident γ rays that the decay of the 86-sec ^{61}Zn populates levels at 476.3, 970.7, 1311.1, 1661.4, 1908.1, 2090.9, 2359.2, 2474.3, 2684.7, 2793.7, 2841.5, and 2932.7 keV. Levels in ^{61}Cu at 1394.9, 1934.8, level 2858.1, 3016.8, and 3090.4 keV are proposed on the basis of observed γ-ray intensities, energy sums, and positions established from studies of nuclear reactions. Many spin assignments were made from present log ft values and previously reported correlation data from studies of nuclear reactions. The half-life of ^{61}Zn was measured and found to be 85.9 ± 0.6 sec. The levels in ^{61}Cu are compared with previously reported theoretical calculations based on current models for the nucleus. (auth)

25872 (d,^{3}He) REACTION ON THE CHLORINE ISOTOPES AT 23.35 MeV. Puttaswamy, N. G.; Yntema, J. L. (Argonne National Lab., Ill.). Phys. Rev., 177: 1624-8(Jan. 20, 1969).

Levels in ^{36}S and ^{34}S up to about 8-MeV excitation energy were studied with the (d, ^{3}He) reactions on ^{37}Cl and ^{35}Cl, respectively. Spectroscopic factors were extracted for four states in ^{36}S and ten states ^{34}S. The levels at 4.58 MeV in ^{36}S and 4.09 MeV in ^{34}S may be the 1^+ states that shell-model calculations predict at 5.75 and 4.97 MeV, respectively. Considerable $d_{3/2}$ strength is seen to the states between 4.71 and 8.0 MeV in ^{34}S, but very little is observed in much the same region of excitation in ^{36}S. (auth)

25873 PROTON EXCITATION IN ^{51}V. Pullen, D. J. (Univ. of Pennsylvania, Philadelphia); Rosner, Baruch; Hansen, Ole Phys. Rev., 177: 1568-72(Jan. 20, 1969).

The ^{50}Ti(^{3}He,d) ^{51}V reaction was studied at 16.4-MeV incident energy with an overall energy resolution of 20 keV full width at half maximum (fwhm). Fifty seven levels in ^{51}V were identified up to 9.5-MeV excitation, and corresponding deuteron angular distributions were recorded in the angular interval 7° to 50°. Spectroscopic information was extracted for 27 of the strongest or most well-isolated transitions by means of a distorted-wave analysis of the differential cross sections. The results are compared with nuclear-structure model predictions. (auth)

25874 NUCLEAR STRUCTURE OF ^{56}Mn. Comfort, J. R. (Yale Univ., New Haven). Contract AT(30-1)-3223. Phys. Rev., 177: 1573-94(Jan. 20, 1969).

The ^{55}Mn(d, p)^{56}Mn reaction was investigated with 10-keV resolution at a deuteron bombarding energy of 7.5 MeV. Angular distributions were obtained for most states up to 5.5 MeV and for strong states up to about 6.5 MeV of excitation energy. A distorted-wave (DW) analysis yielded the orbital angular momentum transfer l_n and the transition strength $(2J_f + 1)\,S_{lj}$ for most states. A comparison with the (d, p) sum rules gives evidence that the DW calculations may be accurate to about 20%. Considerable configuration mixing between the $2p_{3/2}$, $2p_{1/2}$, and $1f_{5/2}$ neutron orbitals was found. A discussion of possible spin assignments is given, particularly for states below 1 MeV. The statistical model is found to be reasonably consistent with the present data, but the distribution of nearest-neighbor spacings has some features of a Wigner, and not an exponential, distribution. Shell-model calculations are discussed, and the possibility that ^{56}Mn may have a large static deformation is considered. (auth)

25875 STUDY OF THE LEVEL STRUCTURE OF ^{47}Ti USING ^{46}Ti (n,γ) REACTION. Tenenbaum, J. (Nuclear Research Center, Negev, Israel); Moreh, R.; Wand, Y.; Arad, B.; Ben-David, G. Phys. Rev., 177: 1595-1605(Jan. 20, 1969).

The capture γ-ray spectrum resulting from thermal-neutron capture in ^{46}Ti was measured using a 30-cc Ge(Li) detector. Some 19 new γ lines corresponding to transitions between levels of ^{47}Ti were observed. The neutron separation energy of ^{47}Ti was found to be 8884 ± 7 keV. Angular correlation measurements were carried out, using NaI(Tl) detectors, and the spins of the following levels in ^{47}Ti were obtained: 1.556 ($3/2$), 1.798 ($3/2$), 2.556 ($3/2$), 3.685 ($1/2$ or $3/2$), and 3.925 MeV ($3/2$ or $1/2$). Some of these results disagree with those obtained by Lee and Schiffer, who established the spins according to the J-dependence rule for the angular distributions in (d, p) reactions. Some indication of a direct capture mechanism for the (n, γ) reaction process is presented. The role of the direct capture mechanism in the ^{46}Ti(n,γ) reaction is discussed. (auth)

25876 SPIN AND NUCLEAR MOMENTS OF THE ^{63}Zn GROUND STATE. Laulainen, N. S.; McDermott, M. N. (Univ. of Washington, Seattle). Phys. Rev., 177: 1606-15(Jan. 20, 1969).

The hyperfine structure of the (4s4p) $^3P_1$ state of 38-min ^{63}Zn was determined by the optical double-resonance technique. The measurements yield a nuclear spin $I = 3/2$, a dipole interaction constant $A_{63}(^3P_1) = -326.57$ (4) MHz, and a quadrupole interaction constant $B_{63}(^3P_1) = -34.46$ (3) MHz. If the hyperfine-structure anomaly and quadrupole shielding effects are neglected, the nuclear magnetic moment with diamagnetic correction is $\mu_{63} = -0.28156$ (5) μ_N, and the nuclear quadrupole moment $Q_{63} = +0.29$ (3) b. The ratio of the ^{63}Zn and ^{67}Zn quadrupole moments is $Q_{63}/Q_{67} = 1.8347$ (13), independent of the quadrupole shielding correction. This work represents the first successful application of the double-resonance method to nuclei with half-lives $\gtrsim 1$ hr. (auth)

25877 STATE-DEPENDENT EFFECTIVE CHARGE IN THE 2p-1f SHELL. Federman, Pedro; Zamik, Larry (Rutgers–The State Univ., New Brunswick, N. J.). Phys. Rev., 177: 1534-40(Jan. 20, 1969).

Motivated by a desire to understand the electric quadrupole transition rates in ^{58}Ni, calculations of the effective charge for both neutrons and protons were carried out, first with ^{40}Ca as a core and then with ^{56}Ni. The calculation was done in perturbation theory using the Kallio–Kolltveit interaction. Concerning state dependence, it was first observed and then proved that in the limit in which energy differences in the 2p-1f shell were small compared with $2\hbar\omega$ excitations, the effective charge depended on the initial and final orbital angular momentum of a given transition, but when these l's were specified, it was independent of the initial and final j values. The effective-charge correction was much bigger for a neutron than for a proton. This may have the effect of reducing the isovector part of the quadrupole operator and hence causing $\Delta T = 1$ transitions to be inhibited. The effective charge is substantially larger with ^{56}Ni as a core than with ^{40}Ca as a core, but is somewhat too small to explain the E2 transition from the first excited 2_1^+ stage to ground. The effect of state dependence in the examples considered was to change certain E2 rates by a factor of 1.5 to 2. In ^{58}Ni, the E2 ratio $2_2^+ \to 0_1^+/2_2^+ \to 2_1^+$, if calculated with shell-model wave functions, is extremely sensitive to the two-body interaction that is used. For example, it is about sixty times smaller (and closer to experiment) if Kuo's matrix elements, which are derived from a realistic interaction, are used rather than matrix elements chosen to give a least-squares fit to the energy levels of the nickel isotopes. If only one of the matrix elements obtained from the energy fit is changed by 0.3 MeV, the ratio becomes forty-two times smaller, also closer to the experimental value. The possibility that a low-lying 2^+ state was basically a 3p-1h state was examined. The lowest two such states had very weak E2 transitions to ground and therefore did not at all resemble the one-phonon state or the electric quadrupole state. By themselves, these states fail as candidates, not only for the 2_1^+ state but also the 2_2^+ state because they radiate more to the ground than to the 2_1^+ state. (auth)

25878 ISOSPIN-FORBIDDEN COMPOUND NUCLEAR RESONANCES IN ^{25}Al AND ^{29}P. Teitelman, B.; Temmer, G. M. (Rutgers–The State Univ., New Brunswick, N. J.). Phys. Rev., 177: 1656-70(Jan. 1969).

The analogs of the ground state and first excited state of ^{26}Na and ^{29}Al were studied as compound resonances in ^{25}Al and ^{29}P, respectively, formed by scattering protons from ^{24}Mg and ^{28}Si targets. The accurate excitation energies obtained for these resonances, which are in excellent agreement with their locations

available from delayed-proton, (p, t), and (p, γ) experiments, were used to predict the masses of ^{25}Si and ^{29}S from the isobaric-multiplet mass formula, and to calculate Coulomb-energy differences between the members of these isospin quartets. Total widths (<300 eV) and partial proton widths were extracted for the sharp isospin-forbidden T = 3/2 resonances and compared with the widths of several new T = 1/2 resonances in ^{25}Al and ^{29}P lying in the same region of excitation (7.5 to 10.0 MeV). Shifts are observed between the locations of corresponding analog states in the parent and $T_z = -1/2$ nuclei. (auth)

25879 EXPERIMENTAL HIGH-RESOLUTION INVESTIGATION AND SHELL-MODEL INTERPRETATION OF THE ^{49}Ca GROUND-STATE ANALOG. Wilhjelm, P. (Univ. of North Carolina, Chapel Hill. Duke Univ., Durham, N. C.); Keyworth, G. A.; Browne, J. C.; Beres, W. P.; Divadeenam, M.; Newson, H. W.; Bilpuch, E. G. Phys. Rev., 177: 1553-7(Jan. 20, 1969).

Excitation functions for ^{48}Ca(p,p) at 165° and 105° have been measured from 1.93 to 2.01 MeV. In addition, the reactions ^{48}Ca(p,n)^{48}Sc and ^{48}Ca(p,nγ)^{48}Sc have been observed. Spins, parities, total and partial widths have been assigned. Eleven resonances are observed, eight of which have $J^\pi = 3/2^-$ and are associated with the ^{49}Ca ground-state analog. These $3/2^-$ levels are interpreted in terms of a detailed shell-model calculation. The importance of 4p-3h and higher configurations is noted. (auth)

25880 CROSS SECTIONS FOR THE PRODUCTION OF SOME MILLISECOND ISOMERS BY 14-MeV NEUTRONS. Van Zelst, L. (Instituut voor Kernphysisch Onderzoek, Amsterdam); Meyers, P.; Oosting, J. A. Physica, 39: 463-72(Aug. 26, 1968).

Millisecond isomers were produced by irradiation of several nuclides with 14-MeV neutrons. Cross sections for reactions from targets of Mg, Al, As, Y, In, Pb, and Bi are reported. (auth)

25881 NUCLEAR DATA SHEETS. Nucl. Data, Sect. B, 3: B.3.1.1-B.3.1.174(Jan. 1969).

Keynumbers and keywords are presented for references to nuclear data reported in the period April, 1967 to June, 1967. (J.W.R.)

25882 INVESTIGATION OF THE EXCITED STATES OF ^{58}Fe THROUGH γ EMISSION FOLLOWING THERMAL NEUTRON CAPTURE. Fanger, U.; Michaelis, W.; Schmidt, H.; Ottmar, H. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Phys., A128: 641-67(1969). (In German).

The neutron capture γ-radiation from the reaction ^{57}Fe(n,γ)^{58}Fe was studied using enriched samples of ^{57}Fe (90.7%) as external targets at the Karlsruhe reactor FR-2. Energies and intensities of 100 transitions were determined by applying a Ge(Li) anti-Compton device in the energy range 0.2-2.7 MeV and a five-crystal Ge(Li)-pair spectrometer in the energy range 2-11 MeV. Cascade relationships were found by two-parameter measurements using both a 34 cm^3 Ge(Li) 7.6 × 7.6 cm NaI(Tl) coincidence apparatus and a system with two 10.2 × 12.7 cm NaI(Tl) detectors. A decay scheme is proposed with 24 levels and 70 transitions corresponding to 97% of the intensity of all ^{58}Fe lines observed. The spins of 12 levels could be assigned by γγ-angular correlation measurements, a great part of which is consistent with (t,p) results of Cohen. Multipole mixing ratios of 12 transitions were determined. The excited states are discussed in the framework of vibrational models with little success, and are compared with recently calculated shell-model states showing quite good agreement. The binding energy of the last neutron in ^{58}Fe was found to be 10043.1 ± 1.0 keV as a weighted mean value from 17 cascades. (auth)

25883 LEVELS OF ^{62}Ni AND ^{64}Ni. Beuzit, P. (CEN, Saclay, France); Delaunay, J.; Fouan, J. P.; Cindro, N. Nucl. Phys., A128: 594-608(1969).

The levels of ^{62}Ni and ^{64}Ni were studied by (p,p′) and (p,p′γ) at 12 MeV. Angular distributions were measured for some low-lying levels and their DWBA fits attempted. The study of γ-decays reveals in both isotopes the existence of a group of levels centered around 4.3 MeV showing some of the properties of a presumed "three-phonon" excitation. States at high excitation decaying directly to the ground state which were previously reported in other Ni isotopes, were observed also in ^{64}Ni. (auth)

25884 PROTON PICKUP FROM ^{45}Sc. Hansen, Ole (Univ. of Copenhagen); Jensen, H. Burkal; Chapman, R.; Hinds, S. Nucl. Phys., A128: 527-36(1969).

Angular distributions for 27 α-particle groups were measured in the ^{45}Sc(t,α)^{44}Ca reaction at an incident energy of 12.95 MeV. Values of the transferred orbital angular momentum were assigned from the systematics of (t,α) angular distribution shapes, while relative spectroscopic factors were deduced from a distorted-wave analysis. The $1f_{7/2}$, $1d_{3/2}$ and $2s_{1/2}$ strengths were observed. In addition, a ^{44}Ca(p,p′) experiment was carried out at 10-MeV proton energy with an energy resolution of 6 keV in order to obtain accurate excitation energies. The structure of the ^{45}Sc ground state and of the ^{44}Ca states is discussed. (auth)

25885 THE ^{88}Sr(p,p′)^{88}Sr* REACTION AT 20 MeV AND ANTISYMMETRIZED MICROSCOPIC DWBA. Picard, J. (CEN, Saclay, France); Beer, O.; El Behay, A.; Lopato, P.; Terrien, Y.; Vallois, G.; Schaeffer, R. Nucl. Phys., A128: 481-96(1969).

The elastic and inelastic scattering of 20.2-MeV protons from ^{88}Sr was studied. Angular distributions for the elastic and 14 inelastic groups were measured. The inelastic scattering was compared to the collective model of distorted wave approximation for multipolarities (l) assignment and determination of strength parameter β_l. The inelastic scattering to some states was also compared to coupled channel calculations and distorted wave calculations including antisymmetrization and using a microscopic wave function. In the latter case, reasonable agreement is obtained for the lowest 3^- state but the inaccuracy of the 2^+ and 4^+ states wave functions is reflected in the calculation of the differential cross sections. The effect of antisymmetrization is shown on a simple model. (auth)

25886 THE ^{31}P(t,p)^{33}P REACTION AND THE USEFULNESS OF DOUBLE-STRIPPING IN DISTINGUISHING AMONG SHELL-MODEL CALCULATIONS. Davies, W. G. (Oxford Univ. Univ. of Alberta, Edmonton); Hardy, J. C.; Darcey, W. Nucl. Phys., A128: 465-80(1969).

The reaction ^{31}P(t,p)^{33}P was used to identify the ground state and 18 excited states ^{33}P. The L-values of the neutron pairs transferred to seven of the levels were determined and spectroscopic arguments used to suggest spins and parities. Shell-model calculations were carried out using five sets of two-body interaction matrix elements, and the results were compared to the observed relative peak cross sections. The same calculations were also used in a discussion of the reaction ^{34}S(d,^{3}He)^{33}P and the β^+ decay of ^{33}Ar to T = 3/2 levels in ^{33}Cl. The sensitivity of the two-nucleon transfer reaction to small differences in the calculated wave functions is emphasized. (auth)

25887 LOW-ENERGY EXCITED STATES OF ^{65}Zn FROM THE DECAY OF ^{65}Ga. Balanda, A.; Gasior, M.; Lizurej, H. I.; Niewodniczanski, H. (Inst. of Nuclear Physics, Krakow. Jagellonian Univ., Krakow). Acta Phys. Pol., 35: 301-12(Feb. 1969).

The internal conversion electron spectrum of the gamma transitions following the 15.2-minute decay of ^{65}Ga was measured several times. The half-lives for the individual transitions and the relative internal conversion coefficients were determined. A spin value of $3/2^+$ for the third excited state of ^{65}Zn is suggested. (auth)

25888 THE SPIN–SPIN INTERACTION OF 7.90-MeV POLARIZED NEUTRONS WITH POLARIZED ^{59}Co NUCLEI. Kobayashi, Shinsaku; Nagamine, Kanetada; Uchida, Akira; Katori, Kenji; Imaizumi, Minoru; Mikuni, Akira (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 40: 1451-2(Dec. 1968).

An attempt was made to observe directly the spin–spin interaction by measuring the transmitted intensity of 7.90 ± 0.30-MeV polarized neutrons through polarized ^{59}Co. The interaction appears to reflect the properties of the ground state of ^{59}Co such as magnetic core polarization. Measurements over a large energy range are needed in order to determine further the strength and form of the interaction. (D.C.W.)

25889 THE MAGNETIC MOMENT OF ^{45}Sc. Lutz, O. (Univ., Tuebingen, Ger.). Phys. Lett., 29A: 58-9(Apr. 7, 1969).

The ratio of the Larmor frequencies of ^{45}Sc and ^{2}H was measured, and the magnetic moment of ^{45}Sc was calculated. A solvent isotope effect on the chemical shift of ^{45}Sc in aqueous solutions of Sc ions was found. (auth)

25890 ENERGY SPECTRUM OF CHARGED PARTICLES EMITTED FOLLOWING MUON CAPTURE IN ^{28}Si. Wills, Edward Lloyd. Charlottesville, Va., Univ. of Virginia, 1968. 85p.

Thesis.

The energy spectrum and branching ratio for charged particles resulting after muon capture in ^{28}Si were measured. The spectrum, attributed mainly to proton emission, exhibits a low-energy cutoff at 1.4 MeV and a maximum at about 2.5 MeV from which it decreases approximately exponentially with a decay constant of 4.6 MeV. A branching ratio of 0.15 ± 0.02 charged particle per capture was determined. (Diss. Abstr.)

25891 CORE POLARIZATION EFFECTS ON ELECTROMAGNETIC TRANSITION OPERATORS. Dieperink, A. E. L.; Brussaard, P. J. (Rijksuniversiteit, Utrecht). Nucl. Phys., A129: 33-44(1969).

Effective proton and neutron charges were calculated for the E2 operator in the sd and fp shells in first-order perturbation theory. Second-order corrections were calculated for the M1 operator and ft values for A = 39 and A = 41 nuclei. The realistic Tabakin interaction was employed. (auth)

25892 SELF-CONSISTENCY AND PAIRING AS CAUSES FOR THE ENERGY GAP IN THE NUCLEI ^{58}Fe, ^{72}Ge, AND ^{78}Se. Faessler, Amand; Sauer, P. U.; Wolter, H. H. (Univ., Muenster, Ger.). Nucl. Phys., A129: 21-32(1969).

Hartree–Fock (HF), Bardeen–Cooper–Schrieffer (BCS), two step HF–BCS and Hartree–Fock–Bogolyubov (HFB) calculations were performed on ^{58}Fe, ^{72}Ge and ^{78}Se using the Brink–Boeker force B1. The intrinsic shape was allowed to be axially symmetrically deformed. The pairing was restricted to occur between protons and between neutrons only. In most cases, the calculations yielded approximately the same energy gap for the four above approaches. Therefore, it was concluded that self-consistency and pairing, the two causes for the energy gap, are not additive. They weaken each other. Going from the HF to the HFB approach, one finds a change of the single-particle energies because of the pairing or far from the Fermi surface indirectly via the change of the deformation by pairing. In ^{72}Ge, the inclusion of the pairing unites two relative HF energy minima into one spherical HFB solution. In ^{58}Fe and ^{78}Se, the two-step procedure HF–BCS yields almost the same results as the HFB approach. But in ^{72}Ge, HF–BCS produces two different solutions like HF, which coincide in the HFB theory. (auth)

25893 ^{48}Ca(^{3}He,^{3}He)^{48}Ca AND ^{43}Ca(^{3}He,α)^{47}Ca REACTIONS AT 15 MeV. Fou, C. M.; Zurmuehle, R. W. (Univ. of Pennsylvania, Philadelphia). Nucl. Phys., A129: 138-44(1969).

Optical potential parameters were obtained from the analysis of elastic scattering angular distribution of ^{3}He by ^{48}Ca at 15 MeV. In the ^{48}Ca(^{3}He,α)^{47}Ca reaction it was found that no states in ^{47}Ca up to 8 MeV excitation are excited strongly except the ground state and an unresolved doublet at 2.58 MeV. Distorted wave Born approximation (DWBA) analysis indicates a mixture of $l_n = 2$ and $l_n = 0$ in the transition to this doublet. Spectroscopic factors extracted with various optical potentials are compared. The choice of optical potential parameters for "best fit" DWBA predictions is discussed. (auth)

25894 STUDY ON THE LOW-LYING STATES OF ^{21}Na. Rolfs, C.; Trost, W.; Kuhlmann, E.; Kraemer, R.; Riess, F. (Univ., Freiburg i. B.). Nucl. Phys., A129: 231-40(1969).

A new unbound level at $E_x = 2833 \pm 7$ keV was found in ^{21}Na via the reaction ^{20}Ne(d,nγ)^{21}Na. The state decays mostly by γ-rays to the 1723 and 332 keV levels. This might be the missing $J^\pi = 5/2^+$ level. From n-γ correlation measurements, the spins of ^{21}*Na = 331.9 ± 0.5, 1723 ± 4 and 2432 ± 2 keV are found to be $5/2$ or $3/2$, $\leq 7/2$ and $(1/2)$, respectively. Branching ratios and some mixing ratios are reported. The level schemes of the mirror nuclei ^{21}Na and ^{21}Ne are compared. (auth)

25895 PROJECTED HARTREE–FOCK METHOD AND STRETCH SCHEME: ENERGY LEVELS OF ^{44}Ti. Khadkikar, S. B.; Banerjee, B. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., A129: 220-30(1969).

The energy levels of ^{44}Ti were calculated using the projected Hartree–Fock method and the stretch scheme of Danos and Gillet. A comparison of the results shows that the latter scheme, although successful in reproducing clearly separated "bands" of energy, gives too small a binding energy. (auth)

25896 TRANSITION RATES IN PHONON-PARTICLE COUPLED NUCLEI. Goode, Philip; Zamick, Larry (Rutgers, State Univ., New Brunswick, N. J.). Nucl. Phys., A129: 81-103 (1969).

The low-lying non-normal parity states of ^{41}Ca and ^{39}K (positive-parity and negative-parity spectra respectively) were treated as a particle (hole) coupled to the low-lying negative-parity states of ^{40}Ca (often called vibrational states). These spectra were calculated by the technique of Sherwood and Goswami, in which the RPA is extended from a closed shell to a closed shell plus a particle or hole. The calculated spectra were compared with experimental results. It was observed that the diagonalization of the energy matrix leads to roughly twice the number of physical states. It is shown that the doubling of the number of physical states does not lead to a breakdown of the theory, and a way to distinguish the physical states from the non-physical states is indicated. A method for calculating transition rates in the phonon-particle coupling was developed and was applied to the known electromagnetic transitions in ^{39}K. In the calculated spectra, it was found that two vibrations are usually important, namely, the lowest $J = 3^-$ and 5^- states of ^{40}Ca. It was noted that the concept of a particle coupled to a vibration is ambiguous. The non-orthogonality is handled correctly in this microscopic theory and is quite important in calculating transition rates. The phonon-particle coupling model predicts that the non-normal parity states in ^{41}Ca and ^{39}K lie much lower in energy and are in much better agreement with experiment than according to conventional p-h calculation (TDA). The experimental levels (in MeV) and their calculated transition rates (in Weisskopf units) were 2.82 (2.5, 9), 3.02 (15×10^{-4}, 13×10^{-4}), 3.60 (16, 23), 3.94 (17, 16). The 4p-3h states were not included. Free charges rather than effective charges were used in the calculation of the transition rates. (auth)

25897 0^+ STATE AT 6.24 MeV IN ^{22}Ne EXCITED BY THE REACTION ^{18}O(^{7}Li,t)^{22}Ne. Scholz, W.; Neogy, P.; Bethge, K.; Middleton, R. (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Lett., 22: 949-51(May 5, 1969).

The reaction ^{18}O(^{7}Li,t)^{22}Ne was studied at 12-MeV incident energy. A 0^+ state at 6.24 MeV, which associated with the (4,4) representation of SU(3), is strongly excited. (auth)

25898 PROTON-POLARIZATION MEASUREMENTS AND DISTORTED-WAVE CALCULATIONS FOR ^{52}Cr(d,p)^{53}Cr AT 11 MeV. Bjorkholm, P. J. (Univ. of Wisconsin, Madison); Haeberli, W.; Mayer, B. Phys. Rev. Lett., 22: 955-8(May 5, 1969).

The proton polarization and the vector analyzing power for the reaction ^{52}Cr(d,p)^{53}Cr (g.s.) were measured. From an analysis of the ^{52}Cr(d,d)^{52}Cr and ^{53}Cr(p,p)^{53}Cr elastic scattering cross sections and polarizations, potentials were obtained which, when used in a distorted-wave Born-approximation calculation, provided a good fit to the proton polarization and the deuteron analyzing power. (auth)

Nuclear Properties and Reactions, A ≥ 90

Refer also to abstracts 25813, 25818, 25822, 25836, 25849, 25857, 25860, 25867, 25881, 25942, 25947, 25951, and 25952.

25899 (CEA-R-3513) STUDY OF NIOBIUM ISOTOPES HAVING EXCESS NEUTRONS AND A SHORT HALF-LIFE. Huebenthal, Karlheinz (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1968. 56p. (In French). Dep.

Thesis. Submitted to Grenoble Univ., France.

By irradiating Mo with 14-MeV neutrons, isomers were found for ^{98}Nb (2.8 s half-life) ^{99}Nb (9s) and ^{100}Nb (2.4 s). No isomer of this type seems to exist for ^{96}Nb. Rapid separation methods were developed for isolating ^{98}Zr from fission products, and for separating Zr and Nb. The half-life of ^{98}Zr was measured (31 s) and the formation of ^{98}Nb (2.8 s) from ^{98}Zr (31 s) was found by milking. Rough β and γ measurements of these nuclei are described. The γ spectrum of ^{98}Nb (51 mn) was studied with a high-resolution Ge/Li detector. (auth)

25900 (GA-9057) THE ^{236}U CAPTURE CROSS SECTION. Final Technical Report. Carlson, A. D. (Gulf General Atomic, Inc., San Diego, Calif.). Oct. 30, 1968. Contract AT(04-3)-167. 33p. Dep. CFSTI.

Capture and self-indication measurements were made concurrently on a ^{236}U sample placed in the neutron beam from a 28-MeV electron linac using a fansteel target. Capture cross section curves are shown for the neutron energy range 0.01 eV to 20 keV. Derived gamma and neutron widths are tabulated for 29 resonances from −9.7 to 415 eV, and energies only are given for 34 resonances to 996 eV. The thermal capture cross section (5.1 ± 0.25 b) and resonance capture integral (350 ± 25 b) were derived and compared to the values obtained by other workers. The average s- and p-wave strength functions and average reduced neutron width and average radiative width are given. (L.T.W.)

25901 (IN-1218, pp 73-138) NUCLEAR PROPERTIES. (Idaho Nuclear Corp., Idaho Falls).

CHLORINE-38—beta decay of, γ spectra from (E)
CURIUM-246—alpha decay of, α energies and half-life for (E)
CURIUM-248—alpha decay of, α energies and half-life for (E)
DYSPROSIUM-163—neutron capture at 1.71 and 16.25 eV, γ spectra from resonance (E)
DYSPROSIUM-164—energy levels from dysprosium-163 resonance neutron capture (E)
ERBIUM-166—energy-level transitions in γ vibrational band (E)
ERBIUM-168—energy-level transitions from thulium-168 decay, multipolarity assignments for (E)
EUROPIUM-150—beta and electron-capture decay of, γ singles and coincidence spectra from (E)

GADOLINIUM-155—neutron capture at 0.04, 2.0, 2.6, and 6.3 eV, γ spectra from resonance (E)
GADOLINIUM-156—neutron separation energy from gadolinium-155 resonance neutron capture (E)
—energy levels from gadolinium-155 resonance neutron capture (E)
GADOLINIUM-157—neutron capture by, γ spectra from (E)
—neutron capture at 0.04, 2.8, and 17.1 eV, γ spectra from resonance (E)
GADOLINIUM-158—energy-level transition probabilities for vibrational bands of (E)
—neutron separation energy from gadolinium-157 resonance neutron capture (E)
—energy levels from gadolinium-157 resonance neutron capture (E)
HAFNIUM-182—beta decay of, γ spectra from (E)
HOLMIUM-166—beta decay of, γ spectra from (E)
IRON—proton reactions at 600 MeV, γ spectra and cross sections for (E)
LUTETIUM-172—electron-capture decay of, conversion-electron and γ spectra from (E)
PROTON CROSS SECTIONS—measurements for radioisotope production (E)
RARE EARTH ISOTOPES—energy levels of odd-A deformed, survey on nonrotational
RHODIUM-103—energy-level transitions from ruthenium-103 decay, conversion coefficients for (E)
RUTHENIUM-103—beta decay of, γ and x-ray spectra from (E)
SAMARIUM-147—neutron capture at 3.4 eV, γ spectra from resonance (E)
SAMARIUM-148—neutron separation energy from samarium-147 resonance neutron capture (E)
—energy levels from samarium-147 resonance neutron capture (E)
SAMARIUM-150—energy-level transitions from europium-150 decay (E)
TANTALUM-181—neutron capture by, γ spectra from (E)
TANTALUM-182—energy-level transitions from hafnium-182 decay and tantalum-181 neutron capture (E)
—gamma spectra of isomeric (E)
THULIUM-168—electron-capture decay of, conversion-electron and γ spectra from (E)
URANIUM-239—beta decay of, γ spectra from (E)
YTTERBIUM-172—energy-level transitions from lutetium-172 decay, K conversion coefficients and multipolarities of (E)
(D.C.W.)

25902 (JINR-E6-4311) LIFE-TIME MEASUREMENTS OF EXCITED STATES IN ^{182}Re. Akhmadzhanov, A. J.; Broda, R.; Hrynkiewicz, A. Z.; Molnar, J.; Styczen, J.; Walus, W.; Zvolsky, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1969. 12p. Dep.

The life-times of the 235.7 keV and 263.2 keV levels in ^{182}Re, excited by the decay of ^{182}Os were measured using the delayed γ-γ coincidence method. The following results were obtained: $T_{1/2}$ = 0.57 ± 0.04 μ sec for the 235.7 keV level; $T_{1/2}$ = 5.27 ± 0.16 nsec for the 263.2 keV level. (auth)

25903 (JINR-P7-4339) ESTIMATE OF THE PRODUCTION CROSS SECTION OF TRANSURANIC ELEMENTS IN THE REACTION OF NUCLEI FISSION BY ACCELERATED Xe AND U IONS. Karamyan, S. A.; Oganesyan, Yu. Ts. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1969. 18p. (In Russian). Dep.

An extrapolation calculation of the production cross sections of the ^{294}110 and ^{298}114 isotopes in the reactions U(U,f),U(Xe,f) was made. The obtained cross sections are situated at the level (10^{-29}–10^{-30}) cm^2. Production cross sections were also calculated for different actinide (from Th to Fm) isotopes in the reaction UCXe,f). A number of approximations on the process of the two heavy nuclei fusion and fission of superheavy compound-nucleus were the basis of the calculation. The stability of the results to the change of these assumptions is discussed. (auth)

25904 (JINR-P15-4325) INTERFERENCE EFFECTS IN THE CROSS SECTION OF THE RADIATIVE CAPTURE OF A NEUTRON BY ^{149}Sm NUCLEUS. Kirpichnikov, I. V.; Ryndina, E. Z.; Urbanec, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1969. 12p. (In Russian). Dep.

The cross sections of the radiative neutron capture with excitation of the ^{150}Sm nucleus levels E = 5.53 and 7.21 MeV were measured using a Ge(Li) detector in the neutron energy interval from 0.12 to 1.5 eV. For explaining the observed energy dependences of the cross section, it is necessary to assume the existence of positive (constructive) interference between the first two resonance levels in the cross section. (auth)

25905 (UCRL-18651) I. THE $|\Delta K| = 1$ ELECTRIC DIPOLE TRANSITIONS IN ODD-MASS DEFORMED NUCLEI. II. THE DECAY OF ^{176}Ta TO LEVELS IN ^{176}Hf. Bernthal, Frederick Michael (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1969. Contract W-7405-eng-48. 340p. Dep. CFSTI. Thesis.

Elements of the collective and single-particle nuclear models were combined to provide a unified model interpretation of the $|\Delta K| = 1$ electric dipole transitions in odd-A deformed nuclei. Attention was focused on the uniquely informative set of E1 transitions in ^{177}Hf that results from decay of the singular ^{177m}Lu nucleus. It is shown that the influences of Coriolis coupling, pairing, and octupole vibration-particle coupling may be used to successfully account for the anomalous E1 transition rates in ^{177}Hf, and by implication, in other odd-A deformed nuclei. Precise experimental data have been gathered for comparison with the theory. A detailed experimental study of the decay of ^{176}Ta to levels in ^{176}Hf was performed. Numerous semiconductor detection systems were employed in conjunction with an on-line PDP-7 data acquisition system to gather γ-ray singles, conversion electron, and γ-γ coincidence data on this remarkably complex decay. Over 300 transitions were observed to follow the ^{176}Ta decay, and some 140 of these were placed in the proposed ^{176}Hf level scheme. The experimental data on levels in ^{176}Hf were compared with contemporary theoretical expectations. Attention is also called to the exceptional quantity and quality of information on nuclear properties that can now be expected from the timely marriage of semiconductor-detector and on-line computer technology. The techniques and problems associated with precision γ-ray spectroscopic data acquisition and analysis are discussed. (auth)

25906 CORRELATION OF MASS, ENERGY, AND ANGLE IN MeV-NEUTRON-INDUCED FISSION OF ^{235}U AND ^{238}U. Meadows, J. W. (Argonne National Lab., Ill.). Phys. Rev., 177: 1817-25 (Jan. 20, 1969).

Mass-energy distributions were measured for fission of ^{235}U induced by thermal and by 0.12-, 0.5-, and 6.0-MeV neutrons, and fission of ^{238}U induced by 1.5- and 5.6-MeV neutrons. Concurrent measurements were made at 7°, 45°, and 90° to the incident neutron beam. No dependence of the anisotropy on mass was observed, nor did the average mass values, the average total kinetic energies, or the widths of the distributions show any angular dependence. The average single-fragment energies and provisional masses are consistent with the assumption that in 6.0-MeV-neutron-induced fission of ^{235}U the additional fission neutrons come predominantly from the light fragment. (auth)

25907 ^{208}Pb(t,d)^{209}Pb REACTION WITH 20-MeV TRITONS. Igo, G. J.; Barnes, P. D.; Flynn, E. R.; Armstrong, D. D. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 177: 1831-40 (Jan. 20, 1969).

Spectroscopic factors for the single-neutron states in ^{209}Pb were determined from angular distributions of the ^{208}Pb(t, d)^{209}Pb reaction. The 1.42-MeV level was found to contain only part of the $j_{15/2}$ single-particle strength. A neutron-bound-state well which reproduces the observed level order and spacings of the positive-parity single-particle states and also gives shell-model-like spectroscopic factors is discussed. Both counter-telescope and magnetic-spectrograph techniques were employed, the latter method being used to extend the spectrum to higher excitation energies. A number of previously unreported levels in ^{209}Pb are noted. Elastic-scattering measurements were also carried out and the resulting optical-model analysis used in distorted-wave calculations. These calculations indicate that the (t, d) reaction is insensitive to cutoff radii and to the choice of either of two sets of triton optical-model potentials which fit the elastic-scattering data. (auth)

25908 EFFECT OF EXCITATION ENERGY OF ^{239}U FISSIBLE NUCLEUS ON YIELDS AND KINETIC ENERGIES OF FRAGMENTS. Vorob'eva, V. G.; Kuz'minov, B. D.; Sergachev, A. I.; Tarasko, M. Z. (Inst. of Physics and Electrical Engineering, Obninsk, USSR). Yadern. Fiz., 9: 296-302(Feb. 1969). (In Russian).

Fragments distribution in masses and kinetic energies in the fission of ^{238}U by neutrons with the energy 1.3, 1.4, 1.5, 1.9, 2.9, 5.3, 6.9 MeV was studied. Measurements were analyzed in terms of statistical model. Correlation of the fine structure of fragment yields with the curve of dependence of maximum fission energy on the type of fission is discussed. (auth)

25909 PROBABILITIES OF Eλ TRANSITIONS AND ALLOWED β DECAY IN ODD DEFORMED NUCLEI. Gareev, F. A.; Ivanova, S. P.; Chernei, M. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 9: 308-12(Feb. 1969). (In Russian).

Eλ transitions and allowed β decay in odd deformed nuclei of the rare earth region were studied. The wave functions in the transitions were used as the solutions of a one-particle problem for the Saxon–Woods potential. Contrary to the Nilsson scheme accord-

ing to which the account of the pairing effect on the probability of E1 transitions with $\Delta K = 0$ results in worse agreement with the experimental data, reduced probabilities were obtained which are in satisfactory agreement with experiment. (auth)

25910 MAGNETIC DIPOLE INTERACTIONS IN DEFORMED NUCLEI. Kuliev, A. A.; Pyatov, N. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 9: 313-23(Feb. 1969). (In Russian).

Spin polarization effects in odd-mass deformed nuclei were studied by means of the Tamm–Dancoff method. Amplitudes of three-quasiparticle admixtures and dispersion equation for the energy shift of one-particle levels due to the magnetic dipole interaction were obtained without an intermediate investigation of one-phonon states in even-even nuclei. The theory was used to analyze magnetic dipole moments of nuclei. (auth)

25911 DECAY OF ^{102}Rh AND ^{102m}Rh. Gehrke, R. J.; Helmer, R. G. (Idaho Nuclear Corp., Idaho Falls). Phys. Rev., 177: 1792-7(Jan. 20, 1969).

The decays of the 206-day and 2.9-yr electron-capture activities of ^{102}Rh were studied with a Ge(Li) spectrometer and with a γ-γ coincidence system. From the analysis of γ-ray spectra, measured over a period of ≈ 1.5 years, the γ rays associated with each activity were identified. Twenty-four transitions, nine previously unreported, are assigned to the decay of 206-day ^{102}Rh, and fifteen, six previously unreported, to 2.9-yr ^{102}Rh. All observed transitions except one are placed in a consistent level scheme for ^{102}Ru with levels at 0, 475, 944, 1103, 1106, 1522, 1581, 1837, 2037, and 2261 keV populated by the 206-day activity; and 0, 475, 1103, 1106, 1522, 1795, 1873, and 2219 keV from the 2.9-yr activity. The levels at 944, 1581, and 1799 keV have not been previously reported. The log ft values of the various electron-capture branches are consistent with a spin of 1 for the 206-day level of ^{102}Rh and with a spin ≥ 4 for the 2.9-yr state. A reasonable assignment for the new 944-keV level is 0^+, which suggests that it is associated with the 2^+ and 4^+ two-phonon states reported at 1103 and 1106 keV, respectively. (auth)

25912 EFFECT OF AN ASSUMED PROTON CHARGE HALO ON THE ELASTIC SCATTERING OF ELECTRONS FROM NUCLEI. van Niftrik, G. J. C. (Instituut voor Kernphysisch Onderzoek, Amsterdam); Peterson, G. A.; Rawitscher, George H. Phys. Rev., 177: 1797-1801(Jan. 20, 1969).

Effects of an assumed halo on elastic electron-^{209}Bi scattering cross sections for electrons of less than 150 MeV were calculated by using the Born approximation (BA) and a numerical phase-shift method. The BA estimate is shown to be adequate at energies of 50 MeV and above, and further shows that the relative effect on the cross section due to the protons' possessing a halo is the same for all nuclei. It is found that measurements at both low and high momentum transfers are needed to give information on a proton halo, and the accuracy required is discussed. (auth)

25913 SPIN OF THE 1029-keV LEVEL IN ^{200}Hg. Hopke, P. K. (Princeton Univ., Princeton, N. J. Princeton–Pennsylvania Accelerator, Princeton, N. J.); Naumann, R. A.; Spejewski, E. H. Phys. Rev., 177: 1802-5(Jan. 20, 1969).

A search for 1029-keV photons following the decay of ^{200}Tl was made. These have been observed with a relative intensity $I_{1629}/I_{661} = 0.049 \pm 0.016$. The spin assignment to the 1029-keV level of ^{200}Hg is discussed. (auth)

25914 DELAYED NEUTRON EMISSION IN THE DECAYS OF SHORT-LIVED SEPARATED ISOTOPES OF GASEOUS FISSION PRODUCTS. Talbert, W. L. Jr.; Tucker, A. B.; Day, G. M. (Ames Lab., Iowa). Phys. Rev., 177: 1805-16(Jan. 20, 1969).

Delayed-neutron activity of separated isotopes of krypton and xenon and their decay products was studied. The TRISTAN on-line isotope separator system at the Ames Laboratory Research Reactor was used to provide sources of short-lived gaseous fission products of selected masses, through A = 93 for krypton and A = 142 for xenon. Total delayed-neutron yields for each mass were measured by a calibrated long counter, and the relative yields of the parent and daughter nuclei in an isobaric decay chain were determined by multiscaling the delayed-neutron activity and resolving the contributions for different half-lives. The precursors and delayed neutron emission probabilities determined in this study are ^{92}Kr, 0.040%; ^{92}Rb, 0.012%; ^{93}Kr, 2.60%; ^{93}Rb, 1.65%; ^{141}Xe, 0.054%; ^{141}Cs, 0.073%; ^{142}Xe, 0.45%; and ^{142}Cs, 0.27%. A comparison is made between predictions for delayed-neutron emission from several semiempirical mass formulas and observations for isotopes of As, Br, Kr, Rb, Sb, I, Xe, and Cs. (auth)

25915 YIELD OF K X RAYS EMITTED FROM ^{236}U FRAGMENTS. Kapoor, S. S.; Ramamurthy, V. S.; Zaghloul, R. (Bhabha Atomic Research Centre, Trombay, India). Phys. Rev., 177: 1776-82(Jan. 20, 1969).

The yield of K x rays from different fragment masses were determined in the thermal-neutron-induced fission of ^{235}U. The energies of the pairs of fragments were measured with two semiconductor detectors placed on either side of a thin ^{235}U foil. The K x rays from the light and the heavy groups of fragments were separated by measuring the x-ray energies with a 1-mm NaI(Tl) crystal. The fragment mass distributions in coincidence with the light group of K x rays and with the heavy group of K x rays, and the unbiased mass distributions, were simultaneously recorded in different quarters of a 1024-channel analyzer memory. From these distributions, after suitable corrections for the background, x-rays detection efficiencies, and finite-energy-resolution effects, the number of x rays as a function of fragment mass was determined. The x-ray yield per fission is found to be 0.08 ± 0.01 for the light fragment group, and 0.30 ± 0.02 for the heavy fragment group. The gross features of the yield as a function of mass are similar to those observed earlier for emission from ^{252}Cf fragments. However, unlike the case of ^{252}Cf, for masses greater than 144 the striking increase in the yield is not observed. The present results are consistent with the interpretation that the x-ray yield depends both on the characteristics of the low-lying states and the initial spin of the fragments. (auth)

25916 g FACTORS OF THE 210-keV AND 240-keV STATES OF ^{195}Pt. Varga, L.; Demeter, I.; Keszthelyi, L.; Szoekefalvi-Nagy, Z.; Zamori, Z. (Central Research Inst. for Physics, Budapest). Phys. Rev., 177: 1783-6(Jan. 20, 1969).

The g factors of the 210- and 240-keV states of ^{195}Pt, evaluated from the measured angular rotation in the internal magnetic field after Coulomb excitation, were found to be 0.24 ± 0.06 and 0.104 ± 0.022, respectively, in disagreement with current theoretical predictions. (auth)

25917 MEASUREMENT OF THE NUCLEAR MOMENTS OF THE FIRST-EXCITED STATE OF ^{170}Er BY THE MOESSBAUER EFFECT. Wiggins, J. W.; Walker, J. C. (Johns Hopkins Univ., Baltimore). Phys. Rev., 177: 1786-8(Jan. 20, 1969).

The Moessbauer effect was used to measure the hyperfine splitting of ^{170}Er in $ErFe_2$. Since there is no suitable β-decay parent nuclide, the first-excited state was populated by Coulomb excitation with 3.0-MeV α particles. The same measurement of hyperfine splitting was made for ^{166}Er by using a β-decay source. Assuming the internal field at the Er nucleus in $ErFe_2$ to be an axially symmetric electric-field gradient along the same axis as the magnetic field, a good fit to the data was obtained. The results are $g_R^{170}/g_R^{166} = 1.002 \pm 0.013$ and $Q_1^{170}/Q_1^{166} = 1.05 \pm 0.16$. Using a previously determined value for g_R^{166}, we derive $g_R^{170} = 0.319 \pm 0.011$. (auth)

25918 SPIN AND NUCLEAR MOMENTS OF 55-MIN ^{105}Cd AND 49-MIN ^{111m}Cd. Laulainen, N. S.; McDermott, M. N. (Univ. of Washington, Seattle). Phys. Rev., 177: 1615-23(Jan. 20, 1969).

The hyperfine structures of the $^3P_1$ state of 55-min ^{105}Cd and 49-min ^{111m}Cd were determined by the optical double-resonance technique. For ^{105}Cd, the measurements yield a nuclear spin $I = 5/2$, a dipole interaction constant $A_{105}(^3P_1) = -1025.9(2)$ MHz, and a quadrupole interaction constant $B_{105}(^3P_1) = -103.9(3)$ MHz. For ^{111m}Cd, $I = 5/2$, $A_{111m}(^3P_1) = -697.1(2)$ MHz, and $B_{111m}(^3P_1) = +202.3(5)$ MHz. If the hfs anomaly and quadrupole shielding effects are neglected, the nuclear magnetic dipole moments with diamagnetic correction are $\mu_{105} = -0.7385(2)\ \mu_N$ and $\mu_{111m} = -1.1040(4)\ \mu_N$, and the nuclear quadrupole moments are $Q_{105} = +0.43(4)$ b and $Q_{111m} = -0.85(9)$ b. (auth)

25919 EXPERIMENTAL STUDY OF THE $T = T_z$ STATES IN ^{90}Zr VIA A (^{3}He,d) REACTION. Vourvopoulos, George (Florida A and M Univ., Tallahassee. Florida State Univ., Tallahassee); Fox, J. D. Phys. Rev., 177: 1558-67(Jan. 20, 1969).

^{89}Y(^{3}He, d)^{90}Zr data taken with the Oak Ridge isochronous cyclotron with $E_{^3He} = 25$ MeV are analyzed. Thirty-five states are observed between 5.08- and 8.12-MeV excitation with $l_p = 2$ and $l_p = 0$. These states are considered to be the antianalog single-particle–hole states of the $p_{\frac{1}{2}}^{-1}\ d_{\frac{5}{2}}$, $p_{\frac{1}{2}}^{-1}\ s_{\frac{1}{2}}$, and $p_{\frac{3}{2}}^{-1}\ d_{\frac{5}{2}}$ proton configuration in ^{90}Zr mixed with "core-polarization" states. The possibility exists that there are some additional states of the $p_{\frac{3}{2}}^{-1}\ d_{\frac{5}{2}}$ proton configuration higher than 8.12 MeV. The energy separation between the centroid of each of the $T_< = T_0 - \frac{1}{2}$ groups and the corresponding analogs with $T_> = T_0 + \frac{1}{2}$ is found to be approximately 7 MeV. The strength of the isobaric-spin-dependent potential, responsible for the splitting of the $T_<$ from the $T_>$ states, is calculated to be 148 MeV. Spectroscopic factors are extracted and are compared with theoretical sums of spectroscopic factors. The total number of $T_<$ states seen is in good agreement with the number calculated from considerations of core-polarization states mixed with the antianalog states through nuclear interactions. (auth)

25920 MEASUREMENT OF THE ENERGY RELEASED AS KINETIC ENERGY OF β-PARTICLES EMITTED IN THE RADIOACTIVE DECAY OF THE FISSION PRODUCTS OF ^{235}U. McNair, A.; Bannister, F. J.; Keith, R. L. G.; Wilson, H. W. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Nucl. Energy, 23: 73-86(Mar. 1969).

A measurement of the energy released as kinetic energy of the electrons emitted in the radioactive decay of the fission products of ^{235}U is described. The fission products were produced at a uniform rate during periods that ranged from 10 sec to 10^5 sec and measurements of the energy were made at times ranging from 1 sec to 5×10^5 sec after fission. (auth) (UK)

25921 TOTAL NEUTRON CROSS SECTION OF Gd FOR 16- TO 19-MeV NEUTRONS. Hussain, M.; Chaudhuri, R.; Enayetullah, M.; Islam, E. (Atomic Energy Centre, Dacca, Pakistan). J. Nucl. Energy, 23: No. 2, 113-15(Mar. 1969).

Total neutron cross sections are presented in the range 16.40 to 18.82 MeV in steps of 200 keV with an energy resolution of 50 keV. The method of measurement, a transmission experiment using good geometry, is briefly described. (UK)

25922 A STUDY OF THE ^{232}Th(^{3}He,α)^{231}Th REACTION. Elze, Th. W.; Egidy, T. v.; Huizenga, J. R. (Univ. of Rochester, N. Y.). Nucl. Phys., A128: 564-76(1969).

The ^{232}Th(^{3}He,α)^{231}Th reaction was studied with a 30-MeV ^{3}He beam. From a comparison of the experimental and theoretical (DWBA) angular distributions of the outgoing α-particles and a comparison of measured and calculated spectroscopic factors, the following Nilsson bands are assigned in ^{231}Th: $5/2$[633↓] at 0 keV, $3/2$[631↑] at 75 keV, $5/2$[752↑] at 185 keV and $7/2$[743↑] at 380 keV. The bands $3/2$[642↓] at 812 keV and $3/2$[761↑] (only the $11/2$ state is seen) are tentatively assigned. The spectroscopic factors and energy spacings of several bands are influenced by Coriolis coupling. From the published theoretical expression of the spectroscopic factor for one-nucleon transfer reactions, the differential pick-up cross section for a deformed target with spin zero was developed. (auth)

25923 EXCITED STATES OF ^{98}Mo IN THE RADIOACTIVE DECAY OF ^{98}Nb ISOMERS. Huebenthal, K.; Monnand, E.; Moussa, A. (CEN, Grenoble, France). Nucl. Phys., A128: 577-93(1969).

The decay of the ^{98}Nb isomers was studied. Using Ge(Li) detectors 36 γ-transitions were observed, many of them previously unreported. The beta spectrum was remeasured. $\beta-\gamma$ and $\gamma-\gamma$ coincidence measurements were carried out whenever possible. A level scheme for ^{98}Mo containing 10 excited states is proposed, and compared with previous results. (auth)

25924 GENERALIZED NEUTRON PARTICLE-HOLE STATES IN ^{140}Ce. Wurm, J. P.; Heusler, A.; Von Brentano, P. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys., A128: 433-56(1969).

Angular distributions for the inelastic proton decay of the low-lying isobaric resonances in ^{141}Pr were measured at bombarding energies between E_p = 9.40 and 11.65 MeV. Characteristic groups of particle-hole states in ^{140}Ce were observed in each resonance. The excitation functions for these groups show a negligible non-resonant background. Excitation energies and proton decay widths were determined for states in ^{140}Ce up to E_x = 5.5 MeV. The concept of a generalized neutron particle-hole (GNPH) configuration is introduced. Most of the observed states are found to consist of the GNPH configurations $|(d_{\frac{5}{2}}^{-1}, J\beta)_I\rangle$ and $|(s_{\frac{1}{2}}^{-1}, J\beta)_I\rangle$ mainly. The mixing of the GNPH configurations with other configurations turns out to be weak. (auth)

25925 GAMMA-RAY DECAY SCHEMES OF ^{109g}Pd, ^{111g}Pd AND ^{111m}Pd. Schick, W. C. Jr.; Talbert, W. L. Jr. (Ames Lab., Iowa). Nucl. Phys., A128: 353-87(1969).

The levels of ^{109}Ag and ^{111}Ag excited in the beta decay of ^{109g}Pd, ^{111g}Pd, and ^{111m}Pd were studied through the use of Ge(Li) and NaI(Tl) detectors, both in singles and in coincidence. Twenty-eight γ rays from ^{109g}Pd were placed into a decay scheme involving 11 excited levels in ^{109}Ag. This scheme is very similar to those reported in previous studies of this decay. Approximately 150 γ rays were identified in the decay of ^{111g}Pd and ^{111m}Pd. More than 100 of these were placed into a decay scheme involving 35 excited levels in ^{111}Ag, of which 18 are populated in the decay of ^{111g}Pd and 23 are populated in the decay of ^{111m}Pd. These levels are discussed in terms of several different model interpretations. Of particular interest is a group of levels in ^{111}Ag that may represent a $K = 1/2^+$ rotational band similar to bands reported recently in odd In isotopes. Other levels are not amenable to a simple rotational interpretation, although it is possible that the Ag nuclei are transitional, being rather soft toward deformation. (auth)

25926 TERNARY FISSION OF ^{238}U AND ^{232}Th NUCLEI INDUCED BY 2.9 MeV NEUTRONS. Benisz, J. (Inst. of Nuclear Physics, Krakow. Higher Pedagogical Coll., Katowice, Poland). Acta Phys. Pol., 35: 67-74(Jan. 1969).

The ternary fission mechanism of ^{238}U and ^{232}Th induced by 2.9 MeV neutrons was investigated. Two modes of ternary fission of ^{239}U were determined. The average total kinetic energy of fragments was found to be 174.5 MeV for ternary fission of ^{239}U and 162 MeV for ternary fission of ^{232}Th. The frequency of occurrence of ternary fission relative to binary fission was found to be 8×10^{-4} for fission of ^{238}U induced by 2.9 MeV neutrons and 3×10^{-3} for fission of ^{232}Th induced by 2.9 MeV neutrons. (auth)

25927 NUCLEAR ORIENTATION OF ^{113m}Cd, ^{115}Cd, AND ^{115m}Cd. Chaney, R. L.; McDermott, M. N. (Univ. of Washington, Seattle). Phys. Lett., 29A: 103-4(Apr. 7, 1969).

Nuclear orientation of ^{113m}Cd, ^{115}Cd, and ^{115m}Cd was achieved in gas samples by optical pumping. Measured nuclear resonance frequencies for these isotopes relative to ^{111}Cd are ν_{113m}/ν_{111} = 0.166 232 63(10), ν_{115}/ν_{111} = 1.090 000 2(12) and ν_{115m}/ν_{111} = 0.159 088 42(6). (auth)

25928 THE ^{140}Ce(p,γ)^{141}Pr REACTION THROUGH ISOBARIC ANALOGUE RESONANCES IN ^{141}Pr. Ejiri, H.; Richard, Patrick; Ferguson, S.; Heffner, R.; Perry, D. (Univ. of Washington, Seattle). Nucl. Phys., A128: 388-400(1969).

The ^{140}Ce(p,γ_0)^{141}Pr reaction proceeding through the $2f_{\frac{5}{2}}$ isobaric analog state $|IA\rangle$ of ^{141}Ce was measured with a 20 cm^3 Ge(Li) crystal. A high-energy line of 14.95 MeV was identified as the E1 γ ray from the $7/2^-$ IA resonance to the $5/2^+$ ground state in ^{141}Pr on the basis of the correct γ energy and resonance behavior. The excitation function for the γ rays observed at $\theta_0 = 125°$, where $P_2(\cos\theta_0) \approx 0$, displayed a slightly asymmetric resonance cross section superimposed on a smooth background cross section. The excitation function was analyzed in terms of two interfering processes through the isobaric analog and the semidirect giant resonances. The matrix element of the E1 γ transition $\langle m^\gamma\rangle = \langle r\rangle$ from the $|IA\rangle = (2T_0)^{-\frac{1}{2}} T_-|i\rangle$ of the $2f_{\frac{5}{2}}$ ground state $|i\rangle$ in ^{141}Ce to the $2d_{\frac{5}{2}}$ ground state $|f\rangle$ in ^{141}Pr was obtained to be $|\langle f|em^\gamma|IA\rangle| = (0.063 \pm 0.015)e$ fm. This is smaller than a simple shell model estimates by a factor $F^{\frac{1}{2}} \approx 5$. The corresponding first-forbidden beta matrix element $|\langle f|g_\gamma m^\beta|i\rangle|$, where $g_\gamma m^\beta = (g_\gamma/e)[em^\gamma, T_-]$, was deduced from the observed γ matrix element. By use of the $\langle m^\beta\rangle = g_\gamma\langle r\rangle$ and the log ft value, relations between the beta matrix elements $\langle\sigma \times r\rangle$, $\langle\alpha\rangle$ and $\langle r\rangle$ were obtained. Discussions concerning the γ and beta matrix elements and the (p,γ) reaction mechanism are given in detail. (auth)

25929 STUDY OF N = 82 NUCLEI IN THE REACTION ^{142}Nd(d,^{3}He)^{141}Pr. Baer, Helmut W.; Bardwick, John (Univ. of Michigan, Ann Arbor). Nucl. Phys., A129: 1-9(1969).

The ground state of ^{142}Nd and five states of ^{141}Pr were studied using the reaction ^{142}Nd(d,^{3}He)^{141}Pr at an incident deuteron energy of 29.0 MeV. In the region 0 to 3 MeV excitation of ^{141}Pr, five states at energies 0.0, 0.145, 1.12, 1.30 and 1.61 MeV were observed. The absolute differential cross sections determined for these transitions in the angular range 10 to 40° were analyzed with conventional distorted-wave calculations using the code DWUCK. Transferred angular momentum values and spectroscopic factors were determined. The excitation spectrum of ^{141}Pr is compared with other recent reaction and decay scheme studies and is discussed in the framework of the quasiparticle description. A separate determination of the excitation energy of the first excited state was also obtained by measuring the energy of the γ-ray emitted in the decay of this level following its population in the β^- decay of ^{141}Ce. The measurement was performed with a curved-crystal spectrometer and resulted in the value E_γ = 145.450 ± 0.005 keV. (auth)

25930 REACTION (d,^{3}He) ON THE EVEN–EVEN TIN ISOTOPES. Conjeaud, M.; Harar, S.; Thuriere, E. (Centre d'Etudes Nucleaires, Saclay, France). Nucl. Phys., A129: 10-20(1969). (In French).

Single proton hole states in odd indium isotopes were investigated using the (d,^{3}He) reaction on even tin isotopes at 22 MeV bombarding energy. DWBA calculations using the JULIE code were performed to assign l_p values and to extract spectroscopic factors. A "J-dependence" in the $l_p = 1$ proton transfers was observed; distorted wave calculations predict this effect. The level schemes of residual nuclei are discussed. (auth)

25931 PARTICLE-VIBRATION COUPLING IN ^{209}Pb. Ellegaard, C.; Kantele, J.; Vedelsby, P. (Univ. of Copenhagen). Nucl. Phys., A129: 113-28(1969).

The level structure of ^{209}Pb was investigated by means of proton and γ-ray spectra from the reaction ^{208}Pb(d,pγ)^{209}Pb. The decay scheme of the low-lying levels was established with the aid of (γ)(p) coincidence measurements. Using a high-resolution magnetic spectrograph, 26 levels in ^{209}Pb were found below 4.5

MeV of excitation energy. The angular distributions of the corresponding proton groups were studied and l-values suggested for some of the levels. The observed level structure of ^{209}Pb is compared with that calculated on the basis of a weak-coupling model. The structure of the low-lying states is very satisfactorily explained by the model. At energies well above 3 MeV, the interpretation is complicated by the fact that a large number of levels is populated by small fractions of single-particle strength, possibly from the shell above. (auth)

25932 STUDY OF THE GAMMA RAYS EMITTED BY ^{97}Nb. Singh, B.; Cox, R. J.; Kukoc, A. H.; King, J. D.; Taylor, H. W. (Univ. of Toronto). Nucl. Phys., A129: 104-12(1969).

The decay of 72 min ^{97}Nb formed by the reaction ^{98}Mo(γ,p)^{97}Nb was studied using a 25 cm^3 Ge(Li) counter. The gamma rays associated with the ^{97}Nb decay have energies (intensities) of 657.9 ± 0.5(100), 720 ± 1(0.13), 858.1 ± 1.3(0.04), 908.0 ± 0.8 (0.04), 1024.1 ± 0.5(1.1), 1117.4 ± 0.6(0.07), 1146.7 ± 0.7(0.04), 1268.7 ± 0.5(0.18), 1516.0 ± 0.6(0.13) and 1628 ± 1(0.02) keV. A level scheme for ^{97}Mo is proposed with levels at 657.9 ± 0.5, 720 ± 1, 1024.1 ± 0.5, 1117.4 ± 0.6, 1146.7 ± 0.7, 1268.7 ± 0.5, 1516.0 ± 0.7 and 1628.0 ± 0.8 keV. (auth)

25933 EXCITATION FUNCTIONS FOR THE (d,p) REACTIONS ON ^{96}Ru, ^{102}Ru, AND ^{104}Ru. Mito, A.; Komura, K.; Mitsugashira, T.; Otozai, K. (Osaka Univ.). Nucl. Phys., A129: 165-71(1969).

Excitation functions for (d,p) reactions on ^{96}Ru, ^{102}Ru and ^{104}Ru were measured with the activation method up to 14.0 MeV deuteron energy. The results were explained with the modified Peaslee theory by using different values of the absorption parameter ρ. It was found on the doubly even target nuclei that the values of ρ for (d,p) reactions became large as their isotopic numbers N−Z increase. (auth)

25934 WHY DOES ^{56}Ni DECAY SO SLOWLY. Goode, Philip; Zamick, Larry (Rutgers - The State Univ., New Brunswick, N. J.). Phys. Rev. Lett., 22: 958-60(May 5, 1969).

The decay of the doubly magic nucleus ^{56}Ni to the lowest 1^+ state of ^{56}Co proceeds about a hundred times slower than the shell model predicts. The explanation is that the lowest 1^+ state of ^{56}Co is mostly a two-particle, two-hole state. The giant spin-isospin resonance lies at a higher energy. (auth)

25935 TWO-ELECTRON CONVERSION AND THE EFFECTS OF K-SHELL "SHAKING" DURING DECAY OF ^{203}Hg. Vaishnis, P. P.; Kutsentov, L. M.; Fleisher, V. G. Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 1664-70(1968). (In Russian).

As a result of the rearrangement effect during beta decay, the energy of a transition may be distributed between beta particles, a neutrino and an atomic electron in a single elementary event. The ^{203}Hg isotope in which the single beta transition leads to formation of a 279 keV, excited state in ^{203}Tl was selected as an object of study for the emission of two electrons in adjacent elements. The formation of two holes in the K-shell of Tl, and the rearrangement of the K-shell of Hg during beta decay were investigated by coincidence counting of two x ray quanta of the K-series in the case of two-hole formation, and by coincidence of an x ray quantum of the K-series with the 279 keV gamma quantum in the case of K-shell rearrangement. A tungsten-platinum filter was used with a two-crystal NaI scintillation spectrometer having a high resolving time of 1 to 2 nanoseconds in order to isolate clearly the x ray emission of mercury. The rearrangement probability was found to be $5.1 \pm 2.7 \times 10^{-5}$ per event. The ratio of two-electron conversion to single-electron conversion was found to be $1.6 \pm 0.9 \times 10^{-4}$. (TTT)

25936 DECAY OF ^{103}Pd−^{103m}Rh. Lepri, M. A.; Lyon, W. S. (Oak Ridge National Lab., Tenn.). Int. J. Appl. Radiat. Isotop., 20: 297-8(Apr. 1969).

The parent-daughter system ^{103}Pd−^{103m}Rh has interesting potential for applications in tracer studies, nuclear medicine, and short lived tagging experiments since the 57-min ^{103m}Rh can be continually milked from the 17 day parent. Since the primary measureable radiations from both these nuclides are Rh K X-rays, it seemed of interest to examine the decay scheme of ^{103}Rh and to measure the yield of X-rays and γ rays associated with its decay. (auth)

Nuclear Theory

Refer also to abstracts 25478, 25579, 25647, 25709, 25711, 25781, 25785, 25789, 25822, 25843, 25844, 25847, 25905, and 25912.

25937 (CEA-R-3236) NUMERICAL ANALYSIS OF RESONANCES INDUCED BY s-WAVE NEUTRONS IN TRANSMISSION TIME-OF-FLIGHT EXPERIMENTS WITH A COMPUTER IBM-7094/II. Corge, Charles R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan. 1969. 329p. (In French). Dep.

Thesis.

Numerical analysis of transmission resonances induced by s wave neutrons in time-of-flight experiments can be achieved in a fairly automatic way on an IBM 7094/II computer. The involved computations were carried out following a four step scheme: experimental raw data were processed to obtain the resonant transmissions; values of experimental quantities for each resonance were derived from the above transmissions; resonance parameters were determined using a least squares method to solve the system obtained by equating theoretical functions to the corresponding experimental values; graphical control of the results was performed. (auth)

25938 (IFA-FT-73) MICROSCOPIC DESCRIPTION OF THE TWO PARTICLE STRIPPING ON DEFORMED NUCLEI. Brandus, I.; Dumitrescu, O.; Sandulescu, A. (Academia R. P. R., Bucharest. Institutul de Fizica Atomica). 1968. 27p. Dep.

A microscopic finite range approximation formalism for two-particle stripping reactions on deformed nuclei is developed. A new method for the calculation of the stripping matrix elements is given. The method is based on the expansion of the plane or distorted-wave functions as a product of a Gauss function and an expansion in terms of harmonic oscillator wave functions. The exclusion principle is taken into account, and the exchange contribution to the cross section is obtained. A detailed treatment is given for the case of (α,d) stripping reactions on deformed nuclei. (auth)

25939 (JAERI-1171) PROCEEDINGS OF THE 1st SEMINAR ON NEUTRON CROSS SECTIONS [TOKAI, JAPAN, 15-17 FEBRUARY 1968]. (Japan Atomic Energy Research Inst., Tokai. Tokai Research Establishment). Aug. 1968. 95p. (In Japanese and English). (CONF-680215). Dep.

From 1st Seminar on Neutron Cross Sections, Tokai, Japan.

The 1st Seminar on Neutron Cross Sections was held at the Tokai Research Establishment of the Japan Atomic Energy Research Institute on February 15-17, 1968. About 80 scientists in the fields of nuclear physics and reactor physics participated in the Seminar. The Seminar was devoted to discuss about the evaluation of nuclear data. Reviews on evaluation of nuclear data, several evaluation works, and critical works on evaluated data were reported. (auth)

25940 (KURRI-TR-18) HEAVY-ION NUCLEAR PHYSICS. Report of the Special Research Committee. Hayashi, Takeo; Mukaizaka, Masakatsu (comps.) (Kyoto Univ. (Japan). Research Reactor Inst.). [1966]. 61p. (In Japanese). Dep.

Abstracts of papers dealing with nucleon transfer reactions, compound nucleus processes, heavy ion elastic scattering, calculations of elastic scattering with the optical model, nucleus-nucleus molecular state and related items, experiments at Berkeley (elastic scattering of heavy ions), Coulomb excitation by heavy ions, doppler effect by heavy ions and Coulomb excitation (the Copenhagen experiments), charge transformation collisions of C ion, experiments to study nuclear surfaces using heavy ions, synthesis of transuranium elements by heavy ions, acceleration of C and N ions with the Tokyo University cyclotron, heavy ion sources, linear accelerator for heavy ions, and comparisons of heavy ion acceleration are presented. (TTT)

25941 (ORNL-TM-1866) MODIFICATION AND FURTHER DEVELOPMENT OF THE NUCLEON TRANSPORT CODE, NTC. Irving, D. C.; Moran, H. S.; Kinney, W. E. (Oak Ridge National Lab., Tenn.). Mar. 4, 1969. 53p. Dep. CFSTI.

Several modifications to the Nucleon Transport Code NTC are described. Also, descriptions are provided for a few portions of the code which had previously been undocumented. Included in the report are the description of PREP, a data preparation routine; a generalized framework for the High-Energy Analysis Program which handles the bookkeeping details and leaves the specialization to a particular problem to a few user-written routines; a listing of improvements made in the treatment of evaporation processes; the replacement of an older and incompletely documented version of O5R by the published version; the description of a general-purpose evaporation model program in O5R to treat inelastic scattering; and the preparation of a special version of NTC using a straightahead approximation. (auth)

25942 (RT/FI-(68)50) QUADRUPOLE DIRECT CAPTURE. Longo, G.; Saporetti, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 20p. Dep.

An expression for the cross section for the quadrupole radiative capture of nucleons by nuclei via direct mechanism was ob-

tained. The ^{142}Ce (p,γ) reaction was investigated in the 10 to 50 MeV energy range. It is shown that for proton energies above 20 MeV the quadrupole contribution to the cross section may be of the same order of magnitude as the dipole one. (auth)

25943 (RT/FI-(68)55) FAST NEUTRON RADIATIVE CAPTURE. Longo, G.; Saporetti, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 35p. Dep.

An attempt is made to give a concise account of the present situation in the investigation of the (n,γ) reaction in the 1 to 20 MeV energy range for medium and heavy nuclei. The outlines of the models are given and the available experimental data are briefly reviewed. The results of the analysis, carried out on the basis of the compound nucleus, direct and semidirect capture models, are discussed. (auth)

25944 NOTE ON INTERPRETATION OF FISSION-FRAGMENT ANGULAR DISTRIBUTIONS AT MODERATE EXCITATION ENERGIES. Huizenga, J. R. (Univ. of Rochester, N. Y.); Behkami, A. N.; Moretto, L. G. Phys. Rev., 177: 1826-30(Jan. 20, 1969).

An approximate theoretical expression is presented for calculation of fission-fragment angular distributions at moderate excitation energies. Theoretical anisotropies obtained with this approximate expression are compared with exact theory for different bombarding particles and energies, and the agreement for all cases is very good when the target and projectile spins are zero. (auth)

25945 AVERAGE RESONANCE WIDTHS IN SINGLE-CHANNEL SCATTERING. Moldauer, P. A. (Argonne National Lab., Ill.). Phys. Rev., 177: 1841-2(Jan. 20, 1969).

A proof is given for the relation $T = 1 - \exp[-2\pi\langle\Gamma\rangle/D]$ which connects the transmission coefficient with the average resonance width-to-spacing ratio. (auth)

25946 ELASTIC SCATTERING OF ELECTRONS ON NUCLEI AT ARBITRARY CHARGE DENSITY DISTRIBUTION. Luk'yanov, V. K.; Petkov, I. Zh.; Pol, Yu. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz., 9: 349-56(Feb. 1969). (In Russian).

A method for calculation of the cross section of the electron scattering on nuclei with arbitrary Fermi-like charge density distribution is developed. The method is as follows: the expansion of density in the orthonormalized system of functions produced from derivatives of the Fermi-density and the use of their pole singularities to calculate the amplitude. A good agreement with the exact calculations of cross sections found by numerical solution of the Dirac equation is obtained. An example of the method for the analysis of experimental data is given. (auth)

25947 STATISTICAL DESCRIPTION OF THE FISSION PRODUCT YIELDS. Ignatyuk, A. V. Yadern. Fiz., 9: 357-67 (Feb. 1969). (In Russian).

The influence of the shell structure of the one-particle spectrum on the energy, deformation and density was studied. The yields of the mass and the charge and the mean kinetic energy distribution of fragments with the given mass were calculated in the framework of statistical theory of the fission for ^{236}U. (auth)

25948 COLLECTIVE VIBRATIONS OF NUCLEI IN THEORY OF FINITE FERMI SYSTEMS. Kamerdzhiev, S. P. (Inst. of Physics and Electric Engineering, Obninsk, USSR). Yadern. Fiz., 9: 324-36(Feb. 1969). (In Russian).

Equations of the theory of finite Fermi systems describing low-lying nonrotational states in even-even nuclei are considered in a compact and convenient form for calculations and analysis. The renormalization technique is consistently applied that allows one to extract, calculate and compare with experiment the effects due to the polarizability of the nuclear kernel. The present method is compared with the model "pairing plus qq forces." The limited applicability of this model is shown. The parameters of this model (quadrupole force constant and effective charge) are calculated in terms of constants of the Fermi system theory. (auth)

25949 ON VARIATION OF INERTIAL PARAMETER OF γ BAND. Rakovitskii, S. L. (Inst. of Physics, Tashkent). Yadern. Fiz., 9: 337-8(Feb. 1969). (In Russian).

It is shown for even-even nuclei that the nonregularities in the behavior of the γ-band inertial parameter $A_I = (E_I - E_{I-1})/2I$ disappear, if it is defined by $A_I' = (E_I - E_{I-2})/(4I - 2)$. The direct dependence of A_I' on I is used for calculations of the γ-band levels with high spins for a number of nuclei. (auth)

25950 VIOLATION OF ISOSPIN SELECTION RULES IN PHOTONUCLEAR REACTIONS AND STRUCTURE PROPERTIES OF LIGHT NUCLEI. Mamasakhlisov, V. I.; Macharadze, T. S. (Inst. of Physics, Tbilisi, USSR). Yadern. Fiz., 9: 339-45(Feb. 1969). (In Russian).

The reasons for E1 transitions in the isospin-selection forbidden photonuclear reactions of the type (γ, d) and (γ, α) were analyzed. For the ^{6}Li(γ, d) α reaction the contribution to the cross section was calculated from the direct E1 transitions due to the cluster structure of the nucleus. It is shown that an account of the electric dipole transitions results in an essential asymmetry of the angular distribution. (auth)

25951 EXCITATION-ENERGY DEPENDENCE OF DENSITY OF LEVELS IN HEAVY NUCLEI. Vorotnikov, P. E. (Inst. of Atomic Energy, Moscow). Yadern. Fiz., 9: 303-7(Feb. 1969). (In Russian).

Comparing the density of neutron resonance levels of neighbor nuclei it is shown that contrary to the lighter nuclei, the actinide nuclei at the excitation energy E^*, equal to the neutron bound energy B_n, cannot be described by the Fermi-gas model. The temperature of such nuclei at $E^* = B_n$ is $(1{,}05 \pm 0{,}12)$ MeV and depends on the evenness of the proton and neutron number for the nucleus. The excitation energy corresponding to the phase transition to the Fermi-gas satisfies the inequality $E^* \geq 7$ MeV for the even-even actinide nuclei. (auth)

25952 PARTICLE TRANSFER REACTIONS ON DEFORMED NUCLEI. Kunz, P. D.; Rost, E.; Johnson, R. R. (Univ. of Colorado, Boulder). Phys. Rev., 177: 1737-45(Jan. 20, 1969).

In particle transfer reactions, the effects of strong coupling in the initial and final nuclei can be important, but an exact evaluation is exceedingly complicated numerically. The approximate procedure of Iano and Austern is modified in this work so that the only change from the standard distorted-wave Born-approximation (DWBA) expression is a modification of the optical potentials for the bombarding and exiting particles. The procedure is compared with the Iano-Austern theory and equivalent results are obtained for a ^{24}Mg(d, p)^{25}Mg test case. Comparison with experiment is made for the ^{24}Mg(p, d)^{23}Mg reaction at 27.3 MeV which was measured along with the necessary elastic proton data. A significant improvement in the angular distributions is obtained using the modified DWBA. The method is applied to the ^{182}W(d, p)^{183}W work of Siemssen and Erskine and increases the predicted cross sections as required by the data. (auth)

25953 INFLUENCE OF ELECTROMAGNETIC INTERACTION ON NEUTRON SCATTERING FROM NUCLEI. Hogan, W. S. (Battelle-Columbus Labs., Columbus, Ohio); Seyler, R. G. Phys. Rev, 177: 1706-17(Jan. 20, 1969).

The influence of the interaction between the magnetic moment of a neutron and the Coulomb field of a target nucleus is investigated. A formalism is developed whereby the interaction can be treated exactly in optical-model calculations. Calculations performed at energies of 0.5, 1.0, 7.0, 14.5, and 24 MeV for Al, Mn, Nb, and Bi indicate that the electromagnetic interaction can be adequately treated in the Born approximation. Whereas the influence on the differential cross section is confined to scattering angles less than 2°, the influence on the polarization extends to larger angles corresponding to minima in the cross section. (auth)

25954 NEUTRON SCATTERING FROM NONSPHERICAL NUCLEI. Dunford, Charles L. (North American Rockwell Corp., Canoga Park, Calif.); Fenech, Henri; Reynolds, J. T. Phys. Rev., 177: 395-1405(Jan. 20, 1969).

The scattering of neutrons from nuclei in the energy region where only a few nuclear levels may be excited is studied with a combined nonspherical optical model and statistical compound-nucleus theory. The nuclei studied are even-even nuclei with a low-lying 2^+ state and range from the very light (^{12}C) to the very heavy (^{238}U). The effects of nuclear deformation on the scattering properties are illustrated, and the importance of direct interactions at relatively low incident-neutron energies is demonstrated. (auth)

25955 FEATURES OF ONE-BOSON-EXCHANGE POTENTIAL MODELS. Sawada, T.; Dainis, A.; Green, A. E. S. (Univ. of Florida, Gainesville). Phys. Rev., 177: 1541-7(Jan. 20, 1969).

A number of features and questions related to realistic one-boson-exchange-potential models for the N-N interaction are examined, mainly from a phenomenological viewpoint. They include the validity of the one-pion-exchange region concept and the classical impact-parameter formula, the effect of a discrete versus continuous mass for the I = 0, J = 0 meson field used to simulate the 2π continuum, the effect of an unconstrained versus constrained vector-meson field, the influence of "double regularization" upon phase shifts, and the extension of effective-range theory to velocity-dependent interactions. The objectives are to obtain a physical understanding of the N-N interaction and to provide heuristic guides to the further development of a quantitative theory of the fundamental nuclear force. (auth)

25956 NUCLEON-NUCLEON SCATTERING FROM ONE-BOSON-EXCHANGE POTENTIALS. III. S WAVES INCLUDED. Bryan, Ronald (Texas A and M Univ., College Station); Scott, Bruce L. Phys. Rev., 177: 1435-42(Jan. 20, 1969).

The nucleon–nucleon interaction is described over the laboratory scattering energy range 0 to 350 MeV by a potential used in conjunction with the Schroedinger equation. In momentum space the potential is a superposition of Born terms obtained from single exchanges of ω, ρ, π, η, σ_0, and σ_1 mesons, where the σ_0 and σ_1 are hypothetical scalar mesons with isotopic spin 0 and 1, respectively. Rather than taking the usual static limit, all terms of order p^2/M^2 are retained. The inclusion of S waves requires the introduction of a cutoff factor. The meson coupling constants, the masses of the σ_0 and σ_1, and a cutoff parameter are adjusted to fit the experimentally determined phase parameters. A comparison with experimental phase-shift analysis shows a good qualitative fit, on the average. (auth)

25957 INVERSE SCATTERING PROBLEM FOR SEPARABLE POTENTIALS. Tabakin, Frank (Univ. of Pittsburgh). Phys. Rev., 177: 1443-51(Jan. 20, 1969).

A method for constructing a separable potential directly from the two-nucleon phase shifts is presented. The solution of the inverse scattering problem is extended to include both a long-range attraction and the important strong, short-range repulsion. The occurrence of both an attraction and a strong repulsion in a single separable potential is shown to require that the phase shifts satisfy a modified Levinson theorem. Construction of a noncentral separable interaction directly from known eigenphase shifts and coupling parameters is also discussed. Using the construction procedure described in this paper, the task of repeated phase-shift fitting is avoided, and one can more easily test the sensitivity of nuclear structure calculations to various aspects of the two-nucleon interaction. (auth)

25958 GROUND-STATE ENERGY OF NEUTRON GAS. Wang, Charles T. P. (State Univ. Coll., Oneonta, N. Y.). Phys. Rev., 177: 1452-5(Jan. 20, 1969).

In the calculation of the energy per neutron in the zeroth cluster and first perturbative order at different neutron densities, a complete set of correlated basic functions was used to represent the ground-state wave function for a system of neutron gas. Three potentials, all fitting two-nucleon data, were used. They are the Hamada–Johnston (HJ), Breit, and Brueckner–Gammel–Thaler (BGT) potentials. The results show that the energy decreases monotonically, as neutron density decreases and that the energy values at low densities are nearly the same for all three potentials. But at high densities, the BGT result departs quite markedly from those for HJ and Breit potentials. The results also indicate that a bound state due to the nuclear n-n force alone does not exist for a system of neutron gas. (auth)

25959 PROTON–PROTON BREMSSTRAHLUNG INCLUDING RESCATTERING. Brown, Virginia R. (Univ. of California, Livermore). Phys. Rev., 177: 1498-1513(Jan. 20, 1969).

The theory of proton–proton bremsstrahlung treating the nuclear interaction exactly and the electromagnetic interaction to first order is formulated so as to include the exact determination of the rescattering term. The effect of the Coulomb interaction between the two protons is not considered. The off-energy-shell nuclear matrix elements are written so as to eliminate the necessity of integrating over the nuclear potential. Coplanar symmetric cross sections are calculated with the one-boson-exchange momentum-dependent potential of Bryan and Scott and the hard-core potential of Hamada and Johnston, including partial-wave contributions of the nuclear matrix elements with $J \leq 4$. All results include rescattering corrections, which are shown by explicit calculation to be small ($\leq 15\%$). Quantitative agreement with existing experiments, including the characteristic quadrupole photon angular distribution, is obtained. Present experiments are inadequate to differentiate definitively between the Hamada–Johnston hard-core potential and the Bryan–Scott momentum-dependent potential. (auth)

25960 SLATER DETERMINANTS AND QUASIPARTICLE VACUUM STATES CONSTRUCTED FROM A FINITE NUMBER OF FERMION STATES. Navon, A. M. (McGill Univ., Montreal); Bose, A. K. Phys. Rev., 177: 1514-18(Jan. 20, 1969).

A theoretical study of single-particle transformations, quasiparticle transformations, Slater determinants, and quasiparticle vacuum states is made for a given finite number of single-fermion states. The usual unitary single-particle or quasiparticle transformations are generalized. The new transformations are the most general transformations which transform Slater determinants into Slater determinants or quasiparticle vacuum states into quasiparticle vacuum states, and they contain as particular cases Thouless's nonunitary transformation. It is shown that several Brillouin theorems used in Hartree–Fock and Hartree–Bogolyubov variation theories follow from the form of the continuous variations which can be performed in the space of Slater determinants and in the space of quasiparticle vacuum states. (auth)

25961 SPATIAL SYMMETRY AND WAVE FUNCTION OF SYSTEMS WITH THREE AND FOUR NUCLEONS. Fabre de la Ripelle, Michel (CNRS, Orsay, France). Compt. Rend., Ser. B, 268: 121-3(Jan. 13, 1969). (In French).

A system of coordinates permitting one to eliminate the center of mass and to clearly define the symmetry with regard to the exchange of coordinates for nucleons is given for the α particle. The Hamiltonian takes a very symmetric form with this new system. It permits a correspondance between the wave functions for systems with three or four particles to be defined. (J.F.P.)

25962 THE APPLICATION OF THE FADDEEV EQUATIONS TO AN EXACTLY SOLUBLE MODEL. Hennell, M. A. (University Coll., London). pp 557-62 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 2. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.2).

The Faddeev equations were applied to a three-body system consisting of one particle scattered on two bound particles. The results were in fair agreement with an exact solution. (J.W.R.)

25963 NUCLEAR THREE-BODY PROBLEM. Delves, L. M. (Univ. of Sussex, Brighton, Eng.). pp 153-247 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 1. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.1).

The formalism for treating the nuclear three-body problem is presented. Methods and potentials for studying various properties of ^{3}H and ^{3}He bound states as well as zero energy n-d scattering are described. The present status of the theory of three-body forces is discussed. (J.W.R.)

25964 NUCLEON CLUSTERS IN p-SHELL NUCLEI. Neudatchin, V. G. (Moscow State Univ.). pp 249-79 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 1. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.1).

The cluster model for p-shell nuclei, based on the idea of dividing the nucleus into subsystems according to the rows of the Young scheme, is described. The use of the model for describing direct nuclear reactions and quasielastic knockout of clusters is illustrated. (J.W.R.)

25965 REMARKS ON THE ONE-BOSON-EXCHANGE POTENTIAL AS THE ELEMENTARY PARTICLE PHYSICS CANDIDATE FOR THE REALISTIC NUCLEAR FORCE. Signell, Peter (Michigan State Univ., East Lansing). pp 283-5 of Few Body Problems, Light Nuclei, and Nuclear Interactions. Vol. 1. Paic, Guy; Slaus, Ivo (eds.). New York, Gordon and Breach, Science Publishers, 1968.

From Symposium on Light Nuclei, Few Body Problems, and Nuclear Forces, Brela, Yugoslavia. See CONF-670629-(Vol.1).

After a review of previous research it is concluded that the one-boson-exchange potential is not yet a good candidate for the realistic nuclear force. (J.F.P.)

25966 CLUSTER CONFIGURATIONS IN NUCLEI. Meyer, Eugene Jr. (Lewis Coll., Lockport, Ill.). Amer. J. Phys., 37: 296-304(Mar. 1969).

The cluster model of the nucleus is formulated and qualitatively applied to nuclear spectroscopy and nuclear fission. The correlation of states predicted by the cluster model to experimentally known states is presented for twenty nuclei whose structures are built on the clusters ^{40}Ca, ^{48}Ca, ^{56}Ni, and ^{90}Zr plus an alpha, proton, deuteron, triton, or ^{3}He. (auth)

25967 ON THE USE OF VELOCITY-DEPENDENT POTENTIALS FOR THE INTERPRETATION OF NUCLEON–NUCLEON SCATTERING DATA. Appel, Kurt (Technische Univ., Hanover). Nucl. Phys., A128: 668-72(1969).

It is shown that of the two proposed forms of velocity-dependent potentials, $V_1 = (\lambda/m)\, p \cdot f_p(r) p$ and $V_2 = (\lambda/2m)(p^2 f_p(r) + f_p(r) p^2)$, and simple radial functions $f_p(r)$, V_1 is of no use for reproducing the energy dependence of the nucleon-nucleon scattering phase shifts. (auth)

25968 ENERGY DEPENDENCE OF THE OPTICAL POTENTIAL FROM A DISPERSION RELATION. Fiedeldey, H.; Engelbrecht, C. A. (Atomic Energy Board, Pelindaba, South Africa). Nucl. Phys., A128: 673-95(1969).

The real part of the optical model potential for neutrons in the energy region 0 to 200 MeV is expressed in terms of the equivalent local potential of an energy-independent real non-local po-

tential and a dispersion integral over an energy-dependent imaginary local potential. By using a non-locality of Yukawan shape, a potential with the same energy dependence can be found as that derived from an energy-independent complex purely non-local potential with Gaussian non-locality in a previous paper. The dispersion approach, however, gives rise to a stronger energy dependence of the geometrical parameters of the nuclear surface. Various other effects of different non-local form factors and different asymptotic energy dependence of the imaginary potential are investigated. (auth)

25969 DYNAMIC MODEL OF ASYMMETRIC FISSION. Hasse, Rainer W. (Univ., Wuerzburg, Ger.). Nucl. Phys., A128: 609-31(1969).

A model is presented for the description of the asymmetric mass distribution in the low-energy fission of the heavy elements. The nucleus is treated as a uniformly charged liquid drop with a correction added to include shell effects. The surface of the drop is described by three parameters. For the specific example $^{235}U + n_{th}$ the classical Hamilton equations of motion of this system are solved numerically from saddle point to scission for 100 sets of random initial values of the coordinates. The resulting distributions of mass and kinetic energy of the fragments as well as the variances of the total kinetic energy distribution are discussed and compared with experiment. (auth)

25970 EXACT SOLUTION OF THE PAIRING PROBLEM IN THE LST SCHEME. Pang, Sing Chin (Univ. of Michigan, Ann Arbor). Nucl. Phys., A128: 497-526(1969).

Exact solutions for the pairing interaction problem in the LST scheme are formulated in terms of the matrix elements of pair creation and annihilation operators for pairs coupled to zero orbital angular momentum. General expressions are given for these matrix elements for states with seniority v = 0 and 1. This makes it possible to study an orbital pairing interaction with different spin singlet and triplet strengths acting in mixed configurations of several single-particle levels. The mathematical formulation of the problem is based on the eight-dimensional quasispin group which is broken down according to the decomposition $O(8) \supset O(6) \supset [O(3) \times O(3)]$, where O(6) corresponds to the usual Wigner supermultiplet symmetry group. A sample calculation for a simple two-level configuration, and states with $v_1 = v_2 = 0$, nucleon numbers of 4, 6, 8, 10, shows that the pairing interaction is very effective compared with the single-particle excitations, and that it tends to make more stable those states built from the largest possible number of α-like grouping of 4 particles. (auth)

25971 AN ALGEBRAIC METHOD FOR THE DECOMPOSITION OF THE REPRESENTATIONS PRODUCT IN Sp_4. Buccella, F. (Univ., Florence. Univ., Rome); Cattani, U. Nuovo Cim., Suppl., 6: 1105-8(1968).

A method for the reduction of the direct product of representations of the symplectic group in four dimensions is presented. This method is based on weight diagrams and characters. It has an application in nuclear physics when treating a model of pairing forces with neutrons and protons in a single j-shell. (J.F.P.)

25972 DIFFERENCES IN OPTICAL MODEL PARAMETERS BETWEEN PAIRS OF ISOTOPES AS FOUND FROM DIFFERENCE FUNCTIONS OF SCATTERING DATA. Thomas, G. L.; Burge, E. J. (King's Coll., London). Nucl. Phys., A128: 545-63(1969).

The relative differences in differential cross sections, and differences in polarization, for pairs of isotopes are fitted to theoretical values of these functions computed from the optical model, for elastic scattering of protons between 12 and 50 MeV. The method eliminates errors is normalization common to the two isotopes, and detects errors in relative normalization and data points of low relative accuracy. Although some trends are found for $^{58,60}Ni$ as a function of energy, most of the present data are either insufficiently accurate or not available at enough energies to allow firm conclusions to be drawn about shifts in parameters and their relation to the symmetry term in the potential, and to nuclear structure effects. (auth)

25973 NOTE ON NUCLEAR STATISTICAL MODEL. Futami, Yasuhiko; Ishihara, Takeshi (Science Univ. of Tokyo. Univ. of California, Riverside). Progr. Theor. Phys. (Kyoto), 40: 1458-60(Dec. 1968).

The effect of correlation on the excitation energy–nuclear temperature relation is considered taking into account pairing correlation among nucleons. The temperature Green function method is used. (D.C.W.)

25974 SPATIAL SYMMETRY IN THE THREE-BODY PROBLEM. Fabre de la Ripelle, M. (Institut de Physique Nucleaire, Orsay, France). Progr. Theor. Phys. (Kyoto), 40: 1454-6 (Dec. 1968).

Symmetry relations that permit the search for the spatial wave function of the ground state of ^3He and T to be placed on a more rational basis are specified. (D.C.W.)

25975 EXISTENCE OF SINGLE-CHANNEL SCATTERING RESONANCES. Swan, Peter (Univ. Laval, Quebec). Nucl. Phys., A129: 156-64(1969).

It is shown for single-channel scattering of l = 0 neutral particles by a monotonically decreasing attractive potential that scattering resonances (as opposed to shape resonances) are possible only for zero incident energy and then only if $\lim_{r\to\infty} r^3 U(r) = 0$. For $l \geqq 1$ neutral particles or for $l \geqq 0$ like or unlike charged particles, broad scattering resonances for $k^2 > 0$ are possible with monotonically decreasing potentials, implying that the phase-shift increases through an odd multiple of $\frac{1}{2}\pi$. Potentials not wholly attractive and monotonically decreasing with r may produce scattering resonances if $k^2 = 0$, l = 0 and $\lim_{r\to\infty} r^3 U(r) = 0$ (neutral particles only) and if $k^2 > 0$, $l \geqq 0$, and $\lim_{r\to\infty} r^2 U(r) = 0$ (neutral and charged particles), a favored case of the latter being a potential surrounded by a high potential barrier. (auth)

25976 STUDY OF THE APPROXIMATIONS USED IN CALCULATIONS ON THE (p,2p) REACTION. Jain, B. K. (Univ. of Surrey, Eng.). Nucl. Phys., A129: 145-55(1969).

The predictions of the di-proton model and the kinetic energy approximation for the (p,2p) reaction are compared and then, using the di-proton model, uncertainties introduced in these calculations due to various approximations and ambiguities are estimated. The localization of the (p,2p) reaction in configuration space is also studied. (auth)

25977 ON A UNIFIED MANY-BODY THEORY OF THE DWBA AND OF THE OPTICAL MODEL. Gross, Dieter (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nucl. Phys., A129: 45-63(1969).

A unified theory of the DWBA and of the optical model was developed in the framework of the many-body theory. It is shown that the energy-averaged inelastic S-matrix is given exactly by a DWBA expression containing proper one-channel optical-model wave functions. The effective interaction, which determines the form factor, is in general complex, non-local and energy dependent. It is shown that it can be determined by the difference of the optical-model potentials of the A- and $(A \pm 1)$-particle nuclei. The current expressions for the optical-model potential imply that the effective interaction is in general not given by the Born approximation even after averaging but will be slowly energy dependent as the optical-model potential. An explicit expression for the effective interaction is given in the random phase approximation. The scattering on even and odd nuclei is discussed separately. (auth)

25978 RADIOACTIVITY GROWTH-DECAY DATA: ANALYSIS BY APPLICATION OF THE LEAST-SQUARES METHOD. Yamamoto, S.; Brown, M. (Naval Radiological Defense Lab., San Francisco). Int. J. Appl. Radiat. Isotop., 20: 209-22(Apr. 1969).

The method of least squares was applied to the analysis of growth-decay counting data and time-dependent gamma-ray pulse-height spectral data obtained from mixtures of genetically related radionuclides. From the counting data estimates could be obtained of the parent activity at the time of start of product growth and of the relative detection efficiencies (i.e., the total detection efficiency for one radionuclide relative to that for another). From the gamma-ray spectral data estimates could be obtained of the spectrum of each radionuclide in the decay chain. A computer program, applicable to both counting data and spectral data, was written for the two- and three-generation cases. This program was tested by analysis of experimental data from $^{99}Mo-^{99m}Tc$, $^{140}Ba-^{140}La$, and $^{95}Zr-^{95}Nb$ mixtures. Results accurate to about ±3% in count rates were obtained. (auth) (UK)

REACTOR TECHNOLOGY

Commercial Power Reactors

Refer also to abstracts 24361, 26022, and 26098.

25979 (ANL-Trans-744) SAFETY OF HEAT EXTRACTION FOR THE BN350 AND BOR REACTORS. Pineiski, A. A.; Bagdasarov, I. E.; Mitenkov, F. M.; Pinchasik, M. S.; Pischin, W. K. Translated by Betty Guttman (Argonne National Lab., Ill.), from Bull. Inform. Sci. Tech. (Paris), No. 122, 53-60(1968). 14p. Dep. CFSTI.

Possible accidents which can occur in the thermal circuits of BN350 and BOR are analyzed. These accidents can lead to the shutdown of the coolant flow in the reactor, in the liquid metal circuits and in the steam circuits. Precautions taken in the facilities to assure the safety of heat extraction are studied. 6 references. (auth)

25980 (APED-5456) IN-CORE NUCLEAR INSTRUMENTATION SYSTEMS FOR OYSTER CREEK UNIT 1 AND NINE MILE POINT UNIT 1 REACTORS. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Aug. 1968. 30p. Dep. CFSTI.

The Oyster Creek and Nine Mile Point boiling water reactors used in-core instrumentation for in-core neutron flux monitoring and automatic safety protection are described. A description of the instrument systems, the criteria which are used to determine the final design and verify the system performance, and a brief summary of the supporting test work are presented. (auth)

25981 (BARC-354) SOME FUELLING AND SAFETY ASPECTS OF RAPP REACTOR. Rastogi, B. P.; Srinivasan, K. R.; Purandare, H. D. (Bhabha Atomic Research Centre, Bombay (India)). 1968. 35p. Dep.

The RAPP reactor has six Co adjuster rods in order to override xenon build-up and to suppress the flux oscillations due to xenon instability. The reactivity and flux perturbation effects due to these adjuster rods are analyzed. The calculations on initial fueling of RAPP with some depleted fuel bundles are presented. 10 references. (auth)

25982 (DOCKET-50213-2) [CONNECTICUT YANKEE ATOMIC POWER PLANT]. IMPROVED CONTROL ROD ABSORBER. [Preliminary Safety Analysis Report], Exhibit C. (Connecticut Yankee Atomic Power Co., [Boston], Mass.). June 5, 1963. 21p. Dep. CFSTI.

Development of a rod cluster control element for a pressurized water reactor is discussed in connection with its use in the Connecticut Yankee Power Reactor. The rod cluster control elements are, generally, useful in pressurized water reactors. The control rod assembly design parameters are described; reactivity worth and power distribution are outlined. Expected advantages and problem areas are delineated. The experimental program is outlined. (M.L.S.)

25983 (DOCKET-50213-3) CONNECTICUT YANKEE ATOMIC POWER PLANT. LICENSE APPLICATION. [Preliminary Safety Analysis Report]. (Connecticut Yankee Atomic Power Co., Boston, Mass.). Sept. 6, 1963. 259p. Dep. CFSTI.

Information on Connecticut Yankee Power Reactor is given on the following broad topics: Introduction and Summary; Site; Containment; Reactor Design; Nuclear Steam Supply Systems including the cooling system, auxiliary system, and waste disposal system; Shielding; Instrumentation and Controls; Secondary System including the main steam and turbine generator, condensate and feedwater system, electrical system, and service systems; Tests and Operation; Administration and Training; and Accidents and Potential Hazards. (M.L.S.)

25984 (DOCKET-50213-4) [CONNECTICUT YANKEE ATOMIC POWER PLANT]. [Preliminary Safety Analysis Report], Amendment 13. (Connecticut Yankee Atomic Power Co., Boston, Mass.). Jan. 11, 1967. 63p. Dep. CFSTI.

Revised information on the containment system for Connecticut Yankee Power Reactor is given. Core nuclear and mechanical design revisions are included. Instrumentation and control system design changes are detailed; diagrams and schematics are shown. Steam and power conversion system design changes are described; schematics are shown. Emergency plans are detailed. (M.L.S.)

25985 (DOCKET-50220-24) NINE MILE POINT NUCLEAR STATION. Final Safety Analysis Report, Amendment 12, Suppl. 7, Exhibit D-9. (Niagara Mohawk Power Corp., Syracuse, N. Y.). Apr. 1969. 35p. Dep. CFSTI.

Normal variation of reactor power with recirculation flow is shown for the Nine Mile Point Power Reactor. Scram trip set point settings are given for the average power range monitoring (APRM) system. Effects of lowering the drywell high pressure trip set point are discussed. Procedures and organization for operation and startup are included. (M.L.S.)

25986 (DOCKET-50244-18) [ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1]. [Preliminary Safety Analysis Report], Amendment 18. (Rochester Gas and Electric Corp., N. Y.). Apr. 1, 1969. 33p. Dep. CFSTI.

The 1968 Annual Report of the Rochester Gas and Electric Corporation, owners of Robert S. Ginna Power Reactor, is included. (M.L.S.)

25987 (DOCKET-50254-13) QUAD-CITIES STATION, UNITS 1 AND 2. FOUNDATION GROUTING. [Preliminary Safety Analysis Report], Amendment 8. (Commonwealth Edison Co., Chicago, Ill. Iowa-Illinois Gas and Electric Co., Davenport, Iowa). Apr. 1, 1969. 278p. (DOCKET-50265-10). Dep. CFSTI.

The program for improving the strata underlying the Quad Cities Power Reactor, Units 1 and 2, site is detailed. Lithology and rock quality profiles are shown. Drilling and grouting procedures are detailed; data are tabulated. (M.L.S.)

25988 (DOCKET-50317-11) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. [Preliminary Safety Analysis Report], Supplementary Information. (Baltimore Gas and Electric Co., Md.). Feb. 7, 1969. 39p. (DOCKET-50318-11). Dep. CFSTI.

Performance of the Emergency Core Cooling Systems (ECCS) for Calvert Cliffs Power Reactor, Units 1 and 2, is assessed. Blowdown analyses are detailed; effects of core flow on surface heat transfer coefficients are shown graphically. Transient hot spot clad temperatures are shown for various coolant line break sizes. Range of adequacy for various safety injection subsystems is given. (M.L.S.)

25989 (DOCKET-50317-12) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. [Preliminary Safety Analysis Report], Amendment 8. (Baltimore Gas and Electric Co., Md.). Feb. 14, 1969. 104p. (DOCKET-50318-12). Dep. CFSTI.

Changes in containment system and engineered safeguards instrumentation and functioning are described. The mechanism of the turbine-induced reactor trip signals is discussed; automatic load reduction processes are outlined. Schematics of the engineered safeguards protective systems are included. The quality assurance program and its execution are detailed. A detailed analysis of the spent fuel storage pool during a tornado is included. (M.L.S.)

25990 (DOCKET-50317-13) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. [Preliminary Safety Analysis Report], Amendment 9. (Baltimore Gas and Electric Co., Md.). Feb. 19, 1969. 13p. (DOCKET-50318-13). Dep. CFSTI.

Hurricane tidal surges at the site of the Calvert Cliffs Power Reactor, Units 1 and 2 are given. A single line diagram is given for the off site power supply. The program for on site meteorological investigations is outlined. (M.L.S.)

25991 (DOCKET-50320-12) THREE MILE ISLAND NUCLEAR STATION, UNIT 2. Preliminary Safety Analysis Report, Amendment 8. (Metropolitan Edison Co., Reading, Pa. Jersey Central Power and Light Co., Morristown, N. J.). Apr. 16, 1969. 32p. Dep. CFSTI.

A tabular comparison of design parameters is given for: Three Mile Island, Units 1 and 2; Oconee, Units 1, 2, and 3; Turkey Point, Units 3 and 4. Loads on engineered safety feature buses are tabulated. A schematic of the nuclear service cooling water system is included. Surveillance of the containment building is discussed. (M.L.S.)

25992 (DOCKET-50333-4) [JAMES A. FITZPATRICK NUCLEAR POWER PLANT]. [Preliminary Safety Analysis Report], Amendment 1. (Power Authority of the State of New York). Mar. 27, 1969. 7p. Dep. CFSTI.

Changes in technical qualifications for the Power Authority of the State of New York, owners of James A. Fitzpatrick Power Reactor are delineated. Responsibilities of both the owner and Stone and Webster, who will serve as principal architect-engineer, are assigned. (M.L.S.)

25993 (DOCKET-50340-1) SEABROOK NUCLEAR STATION, UNIT NO. 1. Preliminary Safety Analysis Report, Vol. 1. (Public Service Co. of New Hampshire, Manchester. United Illuminating Co., New Haven, Conn.). Apr. 9, 1969. 542p. Dep. CFSTI.

Information on Seabrook Power Reactor, Unit 1 is given on the following broad topics: Introduction and Summary; Site and Environment; and Reactor. Appendices include: earthquakes which have affected the Seabrook, New Hampshire area with a modified Mercalli intensity of IV or greater, subterranean investigations, boring reports and core drill logs. (M.L.S.)

25994 (DOCKET-50340-2) SEABROOK NUCLEAR STATION, UNIT NO. 1. Preliminary Safety Analysis Report, Vol. 2. (Public Service Co. of New Hampshire, Manchester. United Illuminating Co., New Haven, Conn.). Apr. 9, 1969. 449p. Dep. CFSTI.

Information on Seabrook Power Reactor, Unit 1 is given on the following broad topics: Reactor Coolant System; Containment; Engineered Safeguards; Instrumentation and Control; and Electrical Systems. Appendices include: determination of reactor pressure vessel NDTT; specifications for use of Cadweld process in splicing the reinforcing bar; load factors for the shield building design; consequences of missile generation from turbine failures; design bases for structures, systems, and equipment; dynamic analysis of structures for seismic loading. (M.L.S.)

25995 (DOCKET-50340-3) SEABROOK NUCLEAR STATION, UNIT NO. 1. Preliminary Safety Analysis Report, Vol. 3. (Public Service Co. of New Hampshire, Manchester. United Illuminating Co., New Haven, Conn.). Apr. 9, 1969. 395p. Dep. CFSTI.

Information on Seabrook Power Reactor, Unit 1 is given on the following broad topics: Auxiliary Systems; Steam and Power Conversion Systems; Waste Disposal and Radiation Protection; Conduct of Operations; Initial Tests and Operations; and Safety Analysis. (M.L.S.)

25996 (GEAP-4750) DESIGN AND OPERATION OF AN INSTRUMENTED FUEL SYSTEM. HIGH POWER DENSITY DEVELOPMENT PROJECT. Duckart, A. C. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). June 1968. Contract AT(04-3)-361. 62p. Dep. CFSTI.

The design, development, and operations history of the instrumented fuel assemblies for boiling water reactors, particularly Vallecitos and Big Rock Point, are detailed. An instrumented assembly consists of devices to measure channel inlet and outlet volumetric flow rate, coolant temperatures, and local thermal neutron fluxes. Design specifications are tabulated for the turbine flowmeter, variable reluctance pressure differential transducer, chromel-alumel thermocouple, and fission chambers; readout systems are specified also. The instrumented fuel controls for Vallecitos are shown schematically. Operations histories of instrumented fuel assembly components are summarized; failures and causes of failures are described. Design drawings of the Big Rock Point instrumented fuel assembly are included; the complete experiment rig is described. The operations history is detailed; failures are described. Instrument redesign, calibration, and testing are detailed; results are included. (M.L.S.)

25997 (HN-199) COLLECTION OF RELIABILITY DATA AT NUCLEAR POWER PLANTS. Garrick, B. J.; Shimizu, B.; Gekler, W. C.; Wilson, J. H. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Dec. 1968. Contract AT-(10-1)-205; Subcontract C-623. 95p. Dep. CFSTI.

Requirements are delineated for collecting hardware and experience data at nuclear power plants and processing this information into reliability data for engineered safety systems. Implementation of these requirements is discussed through review of actual collection of experience data and processing of reliability data at the Connecticut Yankee Haddam Neck Nuclear Plant. Organization and establishment of the data collection program are divided into four major tasks: data collection program initiation, component data package preparation, in-plant data collection, and reliability data processing. Each task is delineated in sufficient detail to be able to institute a data collection program at any nuclear power plant. 8 references. (auth)

25998 (KFK-816) THE NUMERICAL CALCULATION OF THE STEAM CYCLE OF NUCLEAR POWER STATIONS. Franze, H. G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Aug. 1968. 137p. (In German). Dep.

Optimization criteria for nuclear power plant design and performance are given. Computer calculations of water and steam entropies are discussed in detail. The Clausius-Rankine steam cycle with preheating is described; advantages and economics of the preheat cycle are evaluated. The interdependence of circuit design and thermodynamic calculations for the reactor installation is analyzed. Data tabulations and detailed analyses are included. (M.L.S.)

25999 (NUS-531) GUIDE FOR ECONOMIC EVALUATION OF NUCLEAR REACTOR PLANT DESIGNS. (NUS Corp., Rockville, Md.). Jan. 1969. Subcontract No. 2904. 303p. Dep. CFSTI.

For Oak Ridge National Lab., Tenn.

This guide presumes that the plant being evaluated will be owned by a U. S. electric utility. The guide aims primarily to estimate the cost of electric energy, but its methodology and data are also useful for process-heat and multipurpose plants. The implications of varying such items as fixed-charge rates, plant capacity factor and number of installations per site are discussed. Using the guide, all plant capital investment, operation and maintenance costs, and fuel costs can be estimated. Various fuels and fuel cycles are considered, and such criteria as net use of fuel resources can be evaluated. In addition, plants using nuclear and fossil fuels in conjunction can be evaluated. Units between 100 and 2000 MWe are given primary attention. Although enough data are given to derive average expected costs for a completely hypothetical situation, specific cost information for the project being considered should be used whenever available. The guide is not intended to be used for final, detailed cost estimates. (auth)

26000 (WAPD-TM-605) ANALYSIS OF XENON POWER OSCILLATIONS IN SHIPPINGPORT PWR CORE 1. England, T. R. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Feb. 1969. Contract AT(11-1)-Gen-14. 163p. Dep. CFSTI.

The stability of Shippingport PWR Core 1 with respect to radial xenon power oscillations is examined. Experimental data are analyzed to establish the stability of Core 1 resulting from both spontaneous and test-induced oscillation during the four seed lifetimes of Core 1 operation. A theoretical treatment, amenable to existing two-dimensional diffusion theory computer programs, is developed. The treatment is applied to the analysis of observed data, lifetime trends of stability, dependence of stability upon power level, and approximate treatment of reactivity feedback mechanisms upon stability. The comparison between observation and calculation shows generally good agreement and indicates that the analytic approach is a practical method for assessing stability trends which result from reactor design changes, fuel management schemes, and lifetime depletion effects. 18 references. (auth)

26001 (ZJE-35) CZECHOSLOVAK WAY OF DEVELOPMENT OF NUCLEAR POWER ENGINEERING. Hulovec, Jan; Komarek, Arnost; Srb, Vladimir; Sevcik, Augustin (Skoda [Works], Pilsen (Czechoslovakia). Nuclear Power Plant Div.). Nov. 1968. 26p. Dep.

A review of the development of nuclear power plants in Czechoslovakia is presented. Predicted power demands and reactor power availability to 1990 are discussed. The parameters for an optimum economic reactor system are analyzed. Descriptions of the A-1 and A-2 power reactors are included. (D.C.C.)

26002 (ZJE-36) STEEL PRESSURE VESSEL FOR NUCLEAR REACTORS. Stepanek, Stanislav (Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Plant Div.). June 1968. 20p. Dep.

The design parameters and fabrication techniques for the Bohunice Power Reactor Unit 1 pressure vessel are presented. The standards established for pressure vessels for other gas-cooled heavy water-moderated natural uranium fueled power reactors are analyzed. 9 references. (D.C.C.)

26003 (ZJE-43) CONTRIBUTION TO THE PROBLEMACY OF TEMPERATURE SHOCKS IN GAS-COOLED REACTORS. Gregor, Jiri; Martinek, Jan (Skoda [Works], Pilsen (Czechoslovakia). Nuclear Power Plant Div.). Sept. 1968. 26p. Dep.

One of the serious problems encountered when designing and constructing gas-cooled nuclear reactors is temperature shocks that have detrimental effects on the primary pipeline. Theoretical and experimental coordinated research of the pipeline, both as to the stress of material and to the production technology, is described. Under conditions of operation at the temperature of about 430°C, the hot pipeline of the primary gas circuit of the A-1 nuclear power plant is exposed to the effects of the inner gas pressure of about 55 kp/cm^2. A reactor shutdown, a sudden temperature fall of the cooling gas to about 120°C occurs at the reactor outlet. This temperature fall induces considerable temperature stress in the pipeline walls. 5 references. (auth)

26004 NUCLEAR POWER PLANTS IN OPERATION, IN CONSTRUCTION, OR IN PLANNING STAGES IN SWITZERLAND. Com. Naz. Energ. Nucl., Notiz., 15: No. 1, 79-82(Jan. 1969). (In Italian).

A brief discussion and projection of present and future power requirements for Switzerland is given. Lucens, Beznau, and Mühleberg are described; design parameters are listed. Plan layout diagrams are shown for Beznau and Mühleberg; a cross sectional diagram of the Mühleberg reactor vessel is included. (M.L.S.)

26005 CALIBRATION OF REACTOR CONTROL RODS USING XENON TRANSIENTS METHODS. Buono, A.; Lesnoni, G. Ing. Nucl., 9: No. 5, 17-22(Sept.-Oct. 1968). (In Italian).

A method used in calibrating the control rods of the Latina Power Reactor is described. The method utilizes the reactivity transients following a large variation in power. The experimental technique is described. Correlation of reactivity with doubling time is discussed. The determination of the calibration curve from the xenon compensation is detailed; data are shown graphically. (M.L.S.)

26006 VERTICAL STEAM GENERATORS FOR PRESSURIZED WATER NUCLEAR PLANTS. Chinaglia, Leopoldo; Crisa, Vincenzo; Dusi, Giambattista; Malambri, Pancrazio. Termotecnica (Milan), 22: 518-28(Nov. 1968). (In Italian).

The function of steam generators in pressurized water nuclear power plants is discussed. Prime characteristics of the steam generators for the BR-3, Trino Power Reactor (SELNI), and Robert E. Guina Power Reactor, Unit 1 are tabulated; comparative diagrams show the relative size of these components. The evolution in size is discussed. Dynamic response of the steam generator to load variations is discussed and is shown graphically. Problems with tube bundle materials are discussed; problems with calculations are listed. Detailed calculational analyses are given for the tubesheet and associated structure; results of calculations are shown graphically. (M.L.S.)

26007 MACHINE FOR THE REPLACEMENT OF FUEL ELEMENTS IN THE KS 150 NUCLEAR REACTOR. Korenek, Jan; Kucera, Zdenek. Skoda Rev., No. 6, 23-6(1968).

A description of the Bohunice Power Reactor Unit 1 loading machine is presented. The on-load refueling machine operates under gas pressure of 60 kp/cm^2 and 112°C inlet temperature. The machine replaces fuel elements individually. (D.C.C.)

26008 ATOMIC POWER PLANT AT JASLOVSKE BOHUNICE. Patrovsky, Vaclav. Skoda Rev., No. 6, 10-21(1968).

A description of the Bohunice Power Reactor Unit 1 is presented. The description includes: site buildings and facilities; plant flow diagram; reactor components; and auxiliary equipment. (D.C.C.)

26009 ANALYSIS OF SUPPLEMENTARY INFORMATION REQUESTED DURING REACTOR LICENSING. Baskin, Kenneth P. (Southern California Edison Co., Camp Pendleton); Sesonske, Alexander. Nucl. Safety, 10: 197-209(May-June 1969).

Applicants for power-reactor construction permits are asked many questions by the AEC. In order to identify the subject and to determine the content of these questions, a study was made of 21 reactor cases. Twenty-four hundred questions were evaluated and categorized, and a qualitative analysis of the total questions per application for reactors that have received their construction permit indicates that, in general, there is less supplementary information required for BWR's than for PWR's, and there is no significant trend regarding the quantity of information asked for over the time period considered. (auth)

26010 ACTION ON REACTOR AND OTHER PROJECTS UNDERGOING REGULATORY REVIEW OR CONSIDERATION. Blakely, J. P. (comp.). Nucl. Safety, 10: 274-84(May-June 1969).

Present power reactor license applications being reviewed or under consideration are described. The procedural steps required for reactor license approval are presented. 20 references. (D.C.C.)

26011 DATA SHEETS ON REACTOR CONTROL: POWER STATION OBRIGHEIM (KWO). Brennst.-Waerme-Kraft, 21: 138-9(Mar. 1969). (In German).

Operation parameters for control of the Obrigheim Power Reactor are listed. (D.C.C.)

26012 ANALYSIS OF CORE PERFORMANCE OF TOKAI REACTOR. Takeda, Atsushi; Kagayama, Tadashi (Japan Atomic Power Co., Tokyo). Nippon Genshiryoku Gakkaishi, 11: 222-9(Apr. 1969). (In Japanese).

Despite numerous technical setbacks and unexpected technical difficulties encountered since November 1965 when the Tokai Nuclear Power Station first increased its power, it has at the end of summer 1968 attained some 1,400 MWd/t in core average irradiation. During this period all the data obtained from daily operation have been constantly analyzed to follow changes in the nuclear and thermal performance brought by the progress of irradiation. An estimation of the core intrinsic reactivity change is made with a reactivity balance equation based on estimating the control rod worth in conjunction with a definition of the additive reactivity component. The method of assessing the maximum can surface temperature is made on the basis of the probability concept by means of statistical technique utilizing a number of data from daily operation. The method used in analyzing the data are outlined, and a brief summary of the results presented. 11 references. (auth)

26013 THE DEVELOPMENT OF ADVANCED GAS COOLED REACTORS IN GREAT BRITAIN. Schoeters, E. Ing. Nucl., 9: No. 6, 7-10(Nov.-Dec. 1968). (In Italian).

Development of Advanced Gas Cooled Reactors (AGR) in England is discussed; the economics of the AGR are considered. Ease of repair and the fuel system are discussed generally. (M.L.S.)

26014 A METHOD FOR ON-SITE TESTING OF ACTIVATED-CARBON FILTERS. Elisei, G.; Longhetto, A.; Persano, A. (ENEL, Rome). Ing. Nucl., 9: No. 4, 19-22(July-Aug. 1968). (In Italian).

The on-site test rig for the activated carbon filters used in the emergency ventilation circuits of the Trino Power Reactor is described; a cross section of the rig is shown. Test conditions are described; test parameters are tabulated. (M.L.S.)

26015 WORLD MARKET FOR NUCLEAR REACTORS. Naets, Guido. Bull. Belgicatom, 12: 13-14(May-June 1967). (In Flemish).

By 1980 the Euratom countries will have constructed 50 stations and invested $25 billion. In the common market there are perhaps 10 to 12 companies which could produce a nuclear reactor independently. Westinghouse and General Electric built 27 of the 32 ordered in the U. S., and exported 15; the U.S.S.R. exported 6, Canada 3, Britain 2, and France 1. A review of world-wide nuclear stations in operation and under construction is presented. (BBB)

26016 PROGRESS AT BEZNAU NUCLEAR POWER STATION. Bertschmann, A. Brown Boveri Rev., 55: 321-2(June 1968).

Work on Beznau I, with a designed net electrical output of 350 MW, is described. (BBB)

26017 THE RADIOLYTIC DECOMPOSITION OF THE MODERATOR IN HEAVY-WATER REACTORS AND THE METHODS FOR ITS SUPPRESSION. Hakl, Josef (Research Inst. of Chemical Equipment, Prague). Jad. Energ., 15: 109-15(Apr. 1969). (In Czech).

The formation of an explosive mixture in the moderator of a heavy water 1-moderated reactor is studied in order to determine the maximum value of its formation rate in the Bohunice Power Reactor. The moderator will be saturated with CO_2 at the pressure up to 60 kp/cm^2. The formation rate of the explosive mixture in this reactor is calculated not to be higher than 200 1/MWh even in the worst operation conditions. The influences of the various factors on the rate of the radiolytic decomposition of water are studied in order to determine the possible methods for the suppression of the formation of the explosive mixture. The available methods are presented and their applicability discussed. (32 references) (auth)

Power Reactor Development

Refer also to abstract 26134.

26018 (ANL-7561) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, MARCH 1969. (Argonne National Lab., Ill.). Apr. 22, 1969. Contract W-31-109-eng-38. 110p. Dep. CFSTI.

Highlights of project activities are summarized for the month of March 1969. Fuel and components development programs for the LMFBR are described. Operations for the ZPR-3 and ZPPR during February are described. Research and development programs in the EBR-2 are reviewed. Nuclear safety studies, including TREAT operations, and chemical separation activities are discussed. (D.C.C.)

26019 (KFK-918) INVESTIGATION OF THE TECHNICAL AND ECONOMICAL SITUATION OF A STEAM COOLED FAST BREEDER REACTOR. Fischer, M.; Seetzen, J.; Jansen, P.; Faude, D. (Kernforschungszentrum, Karlsruhe (West Germany)). Jan. 1969. 44p. (In German). Dep.

Design parameters for a conceptual 1000 MWe steam cooled fast breeder reactor are listed. Fuel element clad materials are discussed. Cooling system design is described; values for hot channel factors with coolant cross mixing are tabulated. Core physics parameters are given. Economic factors and their effects are evaluated; fuel and fuel cycle costs are considered. Further development requirements are outlined; required development costs are projected. Costs of energy production from the light water reactor, fast breeder reactor, and thorium high temperature re-

actor are analyzed from a commercial point of view. Cost data are tabulated for: light water reactors; gas cooled reactors with steam and helium turbines; sodium cooled reactors with oxide and carbide cores; steam cooled reactors; and the helium cooled fast breeder reactor. 35 references. (M.L.S.)

26020 (ZJE-33) OPTIMIZATION OF PARAMETERS OF AN ATOMIC POWER PLANT WITH A PRESCRIBED NET OUTPUT. Mlady, Z.; Vyskocil, V. (Skoda [Works], Pilsen (Czechoslovakia). Nuclear Power Plant Div.). Sept. 1968. 41p. Dep.

The methods and the results of optimizing design parameters for a CO_2-cooled heavy-water moderated natural uranium fueled power reactor are described. The thermodynamic parameters of the power plant and the physical parameters of the active section are judged on the basis of achieving minimum values of the economic criterion. The featured optimization is compared with the optimized parameters of a power plant with a fixed core size. 11 references. (auth)

26021 TREND IN THE DEVELOPMENT OF THE HEAVY-WATER REACTOR IN CZECHOSLOVAKIA. Hulovec, J.; Chlumsky, V.; Flajshanz, M. Skoda Rev., No. 6, 27-33(1968).

A description of the heavy water-moderated power reactor development program in Czechoslovakia is presented. Design parameters for an optimum conceptual 500MW(e) heavy water-moderated gas-cooled power reactor are listed. (D.C.C.)

26022 ENGINEERING AND PERFORMANCE OF PRESSURIZED WATER REACTORS. Altvater, Wolfgang (Technische Stammabteilung Energieversorgung, Erlangen, Ger.). Siemens Rev., 36: 83-95(Mar. 1969).

Typical design features of the reactor core; the pressure vessel and its internals; the coolant circuit; and the overall arrangement of PWRs and PHWRs are described. Refueling procedures, operational behavior and safety aspects of both versions of the Siemens pressurized water reactors are analyzed. (auth)

26023 THE CNEN FAST REACTOR PROGRAM. Ing. Nucl., 9: No. 4, 5-7(July-Aug. 1968). (In Italian).

The fast reactor development program in Italy is discussed. Relation of the program to other fast reactor programs of the world is considered. The PEC fast reactor is discussed from an administrative standpoint. (M.L.S.)

26024 NUCLEAR ENERGY IN 1968. Negrini, R. (Finanziaria E. Breda S.p.A., Milan). Energ. Nucl. (Milan), 16: No. 5, 27-33(May 1969). (In Italian).

A general survey of activities in the commercial nuclear power area is presented. New power reactors ordered in the U. S. from 1965-1968 are listed; installed nuclear power is tabulated as a function of scheduled on-line data. Achievements during 1968 of the various countries are considered. The European nuclear industrial organizations are discussed. Research and development programs and fuel cycle developments are described. (M.L.S.)

26025 NUCLEAR POWER REACTORS AND MOBILE NUCLEAR INSTALLATIONS. Wiesenack, Guenter (Technische Ueberwachungs-Vereine e V, Essen). VDI (Ver. Deut. Ing.) Z., 111: 163-71(Feb. 1969). (In German).

A survey of the growth of nuclear power over the last five years is presented; this is compared to predictions of required installed power until 1978. Tabular summaries of installed nuclear power as of July 31, 1968, are given for world and for OECD countries. Costs and required investment are considered. Thermal efficiencies for the different types of reactors are compared. Nuclear power development in Germany is discussed, specifically. Shipboard reactors are considered briefly. (121 references) (M.L.S.)

Kinetics and Dynamics

Refer also to abstract 24471.

26026 (ANL-7532) ELEMENTARY NEUTRONICS CONSIDERATIONS IN LMFBR DESIGN. Golden, G. H. (Argonne National Lab., Ill.). Mar. 1969. Contract W-31-109-eng-38. 68p. Dep. CFSTI.

Elementary neutronics considerations in the design of liquid-metal-cooled fast breeder reactors (LMFBRs) are described to provide a basic understanding to the scientist or engineer who does not have a background in fast-reactor neutronics. The discussion is not intended to be either a rigorous treatment of the specialized subject of fast reactor physics, or an LMFBR design manual, so rigor is sacrificed frequently for clarity at the desired level. Thus many of the points made are "design-acceptable" approximations that are not absolutely accurate. The subject material is a progression from basic physics concepts to the design of real LMFBRs: flux spectra and cross-section variation with energy in fast reactors; aspects of multigroup calculations in diffusion theory; the significance of breeding and conversion ratios, specific power and doubling time; radial core zoning; refueling (i.e., time-dependent behavior); a discussion of reactivity effects as related to safety, with specific reference to sodium void, Doppler, and expansion effects; and current design approaches. Although the presentation is made within the framework of LMFBR design, it is applicable to the design of any fast breeder, regardless of coolant. Hence, pertinent comments have been made regarding gas-cooled fast breeder reactors. 35 references. (auth)

26027 (BNWL-1013) REPP: A THERMAL HYDRAULIC DESIGN CODE FOR WATER-COOLED REACTORS. Hiatt, R. M.; Bromley, C. Jr. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1969. Contract AT(45-1)-1830. 171p. Dep. CFSTI.

REPP is a digital computer method for designing pressure water and boiling water reactor cores within specified heat transfer and fuel centerline temperature limits. The method incorporates the Westinghouse W-2 and W-3 empirical correlations and a theoretical hot channel model to predict burnout conditions in a rod bundle. Two geometries are considered: rods in a triangular array, and rods in a square lattice. The heat transfer problem solved is a one-dimensional analysis. Pressure drop is considered for four types of fuel-pin spacers. Variable heat generation rate through the fuel-pin and sintering in low density fuels are also included. 28 references. (auth)

26028 (GA-8547) GATT: A THREE-DIMENSIONAL FEW-GROUP NEUTRON DIFFUSION THEORY PROGRAM FOR A HEXAGONAL-Z MESH. Kraetsch, H.; Wagner, M. R. (Gulf General Atomic, Inc., San Diego, Calif.). Jan. 1, 1969. Contract AT(04-3)-167. 68p. Dep. CFSTI.

GATT is a three-dimensional few-group neutron diffusion theory program for calculating the detailed spatial flux and power distribution for reactors with an hexagonal core configuration. The code uses a uniform triangular mesh in the horizontal mesh planes and assumes a relatively simple region structure in the axial direction. The code was designed to represent the special patch-type core structure of the high-temperature gas-cooled gas type reactor. GATT is written in FORTRAN 4 for UNIVAC 1108. (auth)

26029 (KFK-864) NUCLEAR PROPERTIES OF HELIUM-COOLED FAST BREEDER REACTOR. Eisemann, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Oct. 1968. 23p. (In German). (EUR-4155). Dep.

Design parameters for helium cooled fast breeders are tabulated for oxide, metal-cermet, and carbide cores; each type of core is described. Nuclear characteristics for each type of core are tabulated. Calculational methods are discussed; expressions for the nuclear parameters are given. Spectral determinations for each core-type are shown as functions of lethargy and energy. (M.L.S.)

26030 (UJV-2120-R) XENON STABILITY OF REACTOR A2. PART III. Blazek, J.; Krejci, M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Feb. 1969. 40p. (In Czech). Dep.

The xenon stability of a heavy water gas cooled natural uranium power reactor is analyzed. The reactor has neutron flux flattened along the radius and the peak of the active zone as well. The variational principle used here gives the equations for the fundamental mode of the reactor and the equations describing the xenon oscillations of higher modes. The 865U program for solution of these equations and input data tape is given. 16 references. (auth)

Control Systems

Refer also to abstracts 24846, 24854, 25982, and 26047.

26031 (JAERI-1173) MEASUREMENT OF CONTROL ROD WORTHS IN GRAPHITE MODERATED CORE. Kaneko, Yoshihiko; Akino, Fujiyoshi; Kurokawa, Ryosuke; Kitadate, Kenji (Japan Atomic Energy Research Inst., Tokai. Tokai Research Establishment). Nov. 1968. 29p. (In Japanese). Dep.

A systematic compilation is presented of experimental data on the effectiveness of a control rod by the use of pulsed neutron technique in a graphite-moderated 20% enriched U critical assembly SHE. The data used for the compilation are collected from over 300 experimental cases. The philosophy of the choice of experimental conditions is that essential parameters to determine the effectiveness of control rod should be the following: nuclear characteristics of the cores; kind of nucleus of the neutron absorbing material and its density; geometrical factors of

the neutron absorbers of the control rods; and mutual interaction among the control rods. The compilation has been performed with the purpose of checking the accuracy of the control rod worth analysis system applicable to graphite-moderated and heavy water-moderated reactors, which is under developments using SN, and Nordheim and Scalettar method. 22 references. (auth)

26032 (ZJE-42) REACTIVITY COMPENSATION BY MEANS OF MOBILE LATTICES. Krettova, A.; Valenta, V.; Vlachovsky, K. (Skoda [Works], Pilsen (Czechoslovakia). Nuclear Power Plant Div.). Oct. 1968. 25p. Dep.

The use of horizontal control lattices to regulate reactivity in gas-cooled heavy water-moderated power reactors is analyzed. The lattices are designed to move in the direction of the fuel channels. The compensation effect of a lattice depends on the thickness, composition, and position. 13 references. (D.C.C.)

Shielding

Refer also to abstracts 24846 and 24854.

26033 (UJV-2125-R) SUNSPHER, SUNCYL PROGRAMS FOR S_n APPROXIMATION OF TRANSPORT EQUATION IN SHIELDING OF NUCLEAR REACTOR. Burian, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Feb. 1969. 20p. (In Czech.). Dep.

SUNSPHER and SUNCYL computer programs are described which calculate neutron fluxes in multilayer shields of nuclear reactors by Carlson S_n approximation. In spherical geometry the degree of expanding the flux is variable as well as the degree of anisotropic scattering. In cylindrical one dimensional geometry the anisotropic scattering in transport approximation is supposed and the degree of angular terms is variable. Input, output and an example of calculation are shown. The codes are in Algol language for the GIER computer. 6 references. (auth)

Cooling Systems

Refer also to abstracts 24844 and 24852.

26034 (EURFNR-597) A FORTRAN PROGRAM FOR CALCULATING THE THERMODYNAMIC CYCLE PROCESS AND THE COOLING CIRCUIT OF STEAM-COOLED NUCLEAR REACTORS. Spilker, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Translation of report KFK-716. 115p. Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

A digital computer program MAINPROG is described. The program calculates the thermodynamic cycle process and cooling circuit for superheating reactors. The program is written in FORTRAN for the IBM 7040. 8 references. (D.C.C.)

26035 (EURFNR-598) CROSS COOLANT MIXING AND ITS EFFECT ON HOT CHANNEL TEMPERATURES IN STEAM-COOLED FAST REACTORS. Doetschmann, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Translation of report KFK-848. 24p. Dep. CFSTI.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

The calculation for the two core variants of the ENEA reference reactor shows that without coolant cross-mixing in the hot channel, peak temperatures of 739° or 769°C would occur at the clad inside as against rated figures of 597 and 628°C. Even in the event of perfect mixing, these high temperatures are only reduced to 673 and 711°C, because they have several causes, most of which are not influenced by coolant cross-mixing. With the coolant cross mixing which is actually to be expected, the max. clad temperatures are approx. 700 or 735°C. The temperature gain is thus 40 to 35°C. It is also seen that even bigger deviations from the coolant cross-mixing quantities considered would only modify the calculated temperatures slightly. 11 references. (auth)

26036 (GEAP-5466) SEFOR FUEL ASSEMBLY SODIUM FLOW TESTS. Cochran, J. T. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Sept. 1968. Contract AT(04-3)-540. 67p. Dep. CFSTI.

FLOWMETERS—calibration of SEFOR instrumented fuel assembly, data for
PRESSURE GAGES—failure of Barton differential, description of SEFOR coolant sodium-induced
REACTOR FUEL ELEMENTS—flow meters for instrumented SEFOR, calibration data and curves for
SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR—sodium coolant loops for, pressure drop as a function of flowrate for
—fuel assembly for, flow meter calibration for instrumented
—sodium coolant loops for, failure of Barton differential pressure measuring system in
—sodium coolant loop for, procedures and results of disassembly of (M.L.S.)

26037 (GEAP-5680) REACTOR PRIMARY COOLANT SYSTEM RUPTURE STUDY. Quarterly Progress Report No. 13, April-June 1968. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Aug. 1968. Contract AT(04-3)-189. 90p. Dep. CFSTI.

CARBON STEEL—tensile properties of pipes of, effects of fatigue testing on
CHROMIUM ALLOYS AND SYSTEMS—Cr-Mo-steel, crack growth in, effects of temperature and stress on low-cycle fatigue
MOLYBDENUM ALLOYS AND SYSTEMS—Cr-Mo-steel, crack growth in, effects of temperature and stress on low-cycle fatigue
PIPES—crack growth in metal, equations for probability of circumferential, (T)
—crack growth in ASTM A-106B steel seamless, effects of flow configurations on
—stress analysis of elbows in, computer program for
—testing of carbon steel, analysis of fatigue
STAINLESS STEEL—crack growth in Type 304, effects of temperature and stress on low-cycle fatigue
STEEL—crack growth in seamless pipes of ASTM A-106B, effects of flow configurations on
—Cr-Mo-steel, crack growth in, effects of temperature and stress on low-cycle fatigue (D.C.C.)

26038 (GEAP-5716) REACTOR PRIMARY COOLANT SYSTEM RUPTURE STUDY. Quarterly Progress Report No. 14, July-September 1968. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Dec. 1968. Contract AT(04-3)-189. 157p. Dep. CFSTI.

CARBON STEEL—crack growth in ASTM A-212B, effects of temperature and stress on low-cycle fatigue
CHROMIUM ALLOYS AND SYSTEMS—Cr-Mo-steel, crack growth in, effects of temperature and stress on low-cycle fatigue
MOLYBDENUM ALLOYS AND SYSTEMS—Cr-Mo-steel, crack growth in, effects of temperature and stress on low-cycle fatigue
PIPES—crack growth in metal, equations for through-wall low-cycle fatigue
—stress analysis in metal, computer program for
—crack growth in ASTMA-106B steel seamless, effects of flow configurations on
STAINLESS STEEL—crack growth in Type 304, effects of temperature and stress on low-cycle fatigue
STEEL—crack growth in seamless pipes of ASTM A-106B, effects of flow configurations on
—Cr-Mo-steel, crack growth in, effects of temperature and stress on low-cycle fatigue (D.C.C.)

26039 (KFK-815) THREE FORTRAN PROGRAMS FOR DETERMINING THE HOT-CHANNEL TEMPERATURE IN STEAM- AND GAS-COOLED REACTOR CORES WITH CONSIDERATION OF COOLANT MIXING. Doetschmann, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Aug. 1968. 25p. (In German). (EUR-3973). Dep.

Descriptions are given of the C0MIX1, C0MIX2, and C0MIX3 computer programs for calculating coolant and cladding temperatures in hot channels and their neighboring channels. C0MIX1 performs an isobaric calculation for temperatures in a fuel rod bundle with coolant cross mixing; C0MIX2 performs a calculation with pressure drop for a fuel rod bundle with coolant cross mixing; C0MIX3 calculates temperatures in the coolant channels of the fuel rod bundles with coolant cross mixing. Input/output format is given; subroutines and their functions are listed. Flow diagrams are included. Equations solved by the program are listed. (M.L.S.)

26040 (KFK-848) COOLANT MIXING AND ITS EFFECT ON THE HOT-CHANNEL TEMPERATURE IN A STEAM-COOLED REACTOR. Doetschmann, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Oct. 1968. 24p. (In German). (EUR-4151). Dep.

Methods for determining the cross mixing of the coolant in a steam cooled reactor are described. Consequences of cross mixing on the hot-channel temperatures are analyzed. Hot channel factors, with and without cross mixing, are tabulated. Axial temperature distributions for coolant and cladding temperatures are shown as a function of core radius. 11 references. (M.L.S.)

26041 (WAPD-TM-466) CRITICAL HEAT FLUX TESTS ON A COOLANT CHANNEL SIMULATING A CLOSELY SPACED LATTICE OF RODS (LWBR DEVELOPMENT PROGRAM). Green, S. J.; LeTourneau, B. W.; Saladna, E. F.; Sherba, P. S. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Mar. 1969. Contract AT(11-1)-Gen-14. 15p. Dep. CFSTI.

Critical Heat Flux tests were conducted with vertical upflow of water at 1200 to 2000 psia on a uniformly heated 48-inch long channel that simulated a typical reactor coolant flow channel within a bundle of closely spaced rods. Two rod-to-rod spacings were simulated, 0.030 and 0.015 inch. The test results indicate that there was no adverse thermal effect produced by these relatively close spacings. The measured critical heat fluxes were in agreement with data previously obtained with rectangular channels having channel spacings of 0.050 and 0.097 inch indicating a negligible effect of channel spacing over the range 0.015 to 0.097 inch. (auth)

26042 (ZJE-34) DYNAMICS OF THE PRIMARY CIRCUIT OF AN ATOMIC POWER PLANT WITH THE MAIN AND AUXILIARY CIRCULATION BLOWERS IN SERIES. Mueller, V.; Hrstka, V.; Kalivoda, R. (Skoda [Works], Pilsen (Czechoslovakia). Nuclear Power Plant Div.). Sept. 1968. 19p. Dep.

The effects of scram conditions and main blower failures on primary circuit dynamics of an A-1 type atomic power plant are analyzed. A suggestion for a gas circuit with the main and auxiliary blowers in series is investigated. The problem of after-cooling the reactor by means of auxiliary blowers, which cool important structural and shielding parts of the reactor during nominal output is described. The problem was solved by analog computer AP3-M for various running-out times of the circulation blowers. The results were used in selecting a suitable scheme for cooling an A-2 reactor. 9 references. (auth)

26043 INVESTIGATION OF RESISTANCE OF PRESSURE VESSELS OF NUCLEAR REACTORS TO BRITTLE FRACTURES. Kalna, Karol. Skoda Rev., No. 6, 35-46(1968).

Stress analysis results for Czechoslovakia power reactor pressure vessels are presented. The pressure vessels are made of low-carbon steel and are manufactured by welding of roll-bent plates or pressed parts. The vessels are cylindrical in shape and are 5 to 7 m in diameter and 20 to 24 m in height. Analysis of brittle fractures in the pressure vessels is described. (10 references) (D.C.C.)

26044 ANALYTICAL SOLUTION OF HYDRODYNAMIC CHARACTERISTICS OF A STEAM GENERATOR. Zeman, Vladimir; Budajova, Elvira (Technical Univ., Brno). Jad. Energ., 15: 120-4(Apr. 1969). (In Czech).

Flow problems in nuclear power station steam generators with forced circulation are described. The causes of defects in the distribution of the medium into individual domes of the system are analyzed, the reasons being in the connection with the shape of the hydrodynamic characteristics of the dome. A general theoretical relation is derived for the steam generator characteristics with respect to the heat transfer property of the system and its influence on hydraulic resistance. (7 references) (auth)

26045 STARTING AND SHUTTING-DOWN REACTOR CIRCULATORS: AERODYNAMIC MODEL TESTS. Suter, P. Sulzer Tech. Rev., 50: 165-74(1968).

The overall characteristic of a mixed flow blower is determined for the various operating modes of reactor circulators. A peculiar fact emerging is that a delivery may be effected in both directions of flow when the impeller is running in reverse. In addition the blade vibrations in various operating states are indicated. By means of annular air curtains the blading passage of stationary blowers can be sealed against overpressures; with suitably induced swirl it is even possible to achieve a complete seal. Since any pressure fluctuations are liable to endanger the structure of components owing to the high density, measurements concerning the turbulent pressure fluctuations set up in the vicinity of the blower by the diffuser flow are mentioned. Investigations show that circulation blowers can be engineered reliably without mechanical shut-off valves. (7 references) (auth)

Fuels

Refer also to abstracts 24790, 24809, 24846, 24848–24850, 24948, and 24958.

26046 (BNWL-978) EBWR BURNUP DATA. Matsen, R. P. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1968. Contract AT(45-1)-1830. 45p. Dep. CFSTI.

Burnup data are presented from the Pu enriched loading that was irradiated in the Experimental Boiling Water Reactor. The data are plotted in order to detect mismeasurements and to spot subsets which have a pattern different from the remainder of the data. It was expected that the variation in the void fraction of the coolant along the rod might be detected in this way; however, the data do not seem to reflect this effect. The plots do identify seven samples that are different from the others. These samples are from rods that were surrounded by extra water moderator. (auth)

26047 (GEAP-5615) SEFOR INSTRUMENTED FUEL ASSEMBLY DESIGN AND DEVELOPMENT. Craig, E. R. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Apr. 1968. Contract AT(04-3)-540. 61p. Dep. CFSTI.

DATA ACQUISITION SYSTEMS—description of SEFOR on-line
FLOWMETERS—design drawings for SEFOR instrumented fuel assembly magnetic
REACTOR FUEL ELEMENTS—design criteria and drawings for SEFOR instrumented
—instrumentation for SEFOR instrumented
—thermocouples for SEFOR instrumented, design of
—flowmeters for SEFOR instrumented, design drawings for magnetic
—remote lifting fixture for, design of SEFOR
REMOTE HANDLING EQUIPMENT—design of SEFOR instrumented fuel assembly
SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR—fuel assemblies for, design criteria, instrumentation and drawings for instrumented
—data acquisition system for, description of on-line
—coolant channel flow sensors for, test data for
THERMOCOUPLES—design drawings for SEFOR instrumented fuel assembly (M.L.S.)

26048 (ORNL-TM-2548) FAILURE MODES OF ZIRCALOY-CLAD FUEL RODS. PART 2. PROGRAM REVISIONS. Rittenhouse, P. L. (Oak Ridge National Lab., Tenn.). May 1969. Contract W-7405-eng-26. 50p. Dep. CFSTI.

Revisions are proposed to studies related to the loss-of-coolant accident behavior of the Zircaloy-clad fuel rods in light-water reactors. Research and testing being performed by industry and AEC contractors are reviewed and analyzed in light of the revised program requirements. (auth)

26049 (RT/FI-(68)39) COMPARATIVE ANALYSIS OF VARIOUS FUEL CYCLES IN A CIRENE-TYPE REACTOR. Cardosi, G.; Mazzanti, A.; Venditti, P. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 84p. (In Italian). Dep.

Various fuel cycles in heavy water moderated CIRENE type reactors are analyzed from a technical and economic point of view. They are: uranium–thorium cycle; enriched uranium once-through cycle; natural uranium once-through cycle; and uranium–plutonium cycle. The evaluation for all the cycles is done for a 500 MW(e) reactor. The comparison between the various cycles is based on a constant set of economic data and a consistent method of analysis. (auth)

26050 (UJV-2140-R) CORRELATION OF THE FPV-3 PROGRAM AND PROBLEMS OF BURN UP IN REACTOR A2. Kujal, B. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Feb. 1969. 17p. (In Czech). Dep.

The adjustment of the FPV-3 code for fuel burnup calculations in heavy water reactors is presented. For FPV-3 code fitting, the data derived from the operation experience of NPD and Ågesta reactors were used. The results of FPV-3 code adjustment were used for fuel burnup calculations in the A2 reactor. (auth)

26051 TURBULENT HEAT TRANSFER TO HIGH TEMPERATURE GAS IN A CONCENTRIC ANNULUS. Michiyoshi, Itaru; Mitani, Shinji; Takahashi, Osamu (Kyoto Univ.). Nippon Genshiryoku Gakkaishi, 11: 211-15(Apr. 1969). (In Japanese).

Experimental results are reported on local heat transfer coefficients at the surface of an electrically heated mock fuel rod in a concentric annulus with radius ratio of 0.317. Preheated air was used as coolant gas (inlet gas temperature: 20° to 500°C, maximum surface temperature of the mock fuel rod: 660°C). Wall to bulk temperature ratio ranged from near unity to 2.2, and the Reynolds number at the inlet was 20,000 to 75,000. The effects on heat transfer brought by the entrance region and by the temperature-dependency of the physical properties were investigated. 15 references. (auth)

Auxiliary and Emergency Systems

Refer also to abstracts 24364, 24846, 24853, and 24854.

26052 (GA-8639) COMPILATION OF TECHNICAL EVALUATIONS RELATED TO ON-LINE REFUELING MACHINE STUDY

"A." (Gulf General Atomic, Inc., San Diego, Calif.). June 30, 1968. Contract AT(04-3)-167. 69p. Dep. CFSTI.

The shielding calculations and requirements for an on-line "A" refueling machine for a 1000 MW(e) high-temperature gas-cooled reactor are presented. The economics for such a loading machine are analyzed. 9 references. (D.C.C.)

26053 REACTOR INSTRUMENTATION. Haebler, Dietrich v. (Siemens Aktiengesellschaft, Erlangen, Ger.). VDI (Ver. Deut. Ing.) Z., 111: 172-4(Feb. 1969). (In German).

Safety instrumentation for power reactors is discussed. Characteristics which differentiate one type of system from another are considered; the functioning of the various components is outlined. (12 references) (M.L.S.)

Operation and Economics

26054 ECONOMICALLY EFFECTIVE ATOMIC POWER SYSTEM. Hulka, Ivan; Komarek, Arnost. Skoda Rev., No. 6, 4-9(1968).

The economics which regulate optimum world-wide power reactor development are analyzed. The optimum power reactor development model for Czechoslovakia is described. (D.C.C.)

26055 APPRAISAL STUDY OF REPORTED OPERATING EXPERIENCES OF VARIOUS FAST BREEDER REACTORS IN THE WORLD. I, EBR-II. Nakagawa, Hiroshi; Futami, Tsuneo (Tokyo Electrical Power Co., Inc.). Nippon Genshiryoku Gakkasishi, 11: 216-21(Apr. 1969). (In Japanese).

With the aim of appraising the role played by various existing fast breeder reactors in the development of FBR, an analytical review has been made of their operating histories covering the period from criticality to fall 1967, and the technical eventualities experienced at these reactors have been rearranged according to the nature of the events. The important events in the histories of all fast breeder reactors are associated in some way with the problems of adjustment or modification of the mechanical, i.e. the sodium handling, components. Emphasis is placed on the mechanical histories of the sodium components. Another point emphasized is that the valuable experiences accumulated at these reactors should be actively utilized and effectively reflected in future efforts to design more reliable, safer and more economical reactors of this concept. The EBR-2 operations are reviewed. 27 references. (auth)

Safety and Siting

Refer also to abstract 26147.

26056 (RT/ING-(68)18) ON THE STRESS ON THE STRUCTURE OF A REACTOR AS A RESULT OF A NUCLEAR INCIDENT. Curioni, S. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 32p. (In Italian). (PRV-r-(68)15). Dep.

The destructive phenomena associated with a nuclear incident are discussed. A hydrodynamic mathematical model for shock wave effects calculations is given; calculational procedures are described. Dynamic impulse loading effects on reactor structural components are detailed; data are shown graphically. Missile generation effects are discussed; model vessel experiments are described. 71 references. (M.L.S.)

26057 (UJV-2114-Ch) BEHAVIOR OF RADIOIODINE DURING EMERGENCY CONDITIONS IN NUCLEAR POWER REACTOR. Cejnar, F. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Dec. 1968. 107p. (In Czech). Dep.

A review of literature concerning the behavior of radioiodine under accident conditions of nuclear power reactors is presented. This review includes available literature data concerned with the formation, release and transport behavior of airborne radioiodine in power reactor containment systems. Various methods of removal of airborne radioiodine from reactor containment atmospheres are described. Particular attention is devoted to the formation and behavior of methyl iodide vapors under the nuclear reactor accidents. 234 references. (auth)

26058 DESCRIPTION OF A DIGITAL PROGRAM FOR THE CALCULATION OF PARAMETERS ASSOCIATED WITH COMPLEX SYSTEMS. Romanacci, R.; Valeri, A. Ing. Nucl., 9: No. 5, 11-16(Sept.-Oct. 1968). (In Italian).

Procedures for analyzing probabilities and associated effects in complex systems are considered. This is particularly applicable to safety analyses of power reactors where failure probabilities are very low. An array is constructed which shows the interrelation between: failure rate of a single element, combinations, state of the single element, partial probabilities, and decision. A brief description of the VARO computer program for calculation of failure rates of systems components is described; an example is given. The program is written in Fortran IV and can be utilized by the IBM 7090/7094 and the IBM 360/20. (M.L.S.)

26059 PROGRESS SUMMARY OF NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROJECTS. Savolainen, A. W.; Whetsel, H. B. (comps. and eds.). Nucl. Safety, 10: 254-71 (May-June 1969).

Progress in the development programs for boiling and pressurized-water reactor safety is reviewed. (auth)

26060 GENERAL ADMINISTRATIVE ACTIVITIES. Blakely, J. P. (comp.). Nucl. Safety, 10: 271-3(May-June 1969).

The report of an interagency study of problems associated with the siting of nuclear- and fossil-fueled steam electric plants is reviewed. Hazards due to predicted earthquakes are discussed. Radiation exposure levels in uranium mines are analyzed. 7 references. (D.C.C.)

26061 NUCLEAR SAFETY. Volume 10, No. 3. Cottrell, Wm. B.; Jordan, W. H.; Blakely, J. P.; Savolainen, A. W. (eds.). One of Four Technical Progress Reviews Published for the Division of Technical Information, USAEC. Oak Ridge, Tenn., Oak Ridge National Lab., May-June 1969. 91p. GPO $0.60.

Separate abstracts are included for 9 of the 17 papers presented. General topics discussed include: General Safety Conditions; Accident Analysis; Plant Safety Features; Consequences of Activity Release; Operating Experiences; Current Events; and Miscellany. (D.C.C.)

For abstracts of individual papers see: 24315, 24887, 24998, 26009, 26010, 26059, 26060, 26098, and 26099.

26062 BEHAVIOR OF AIRBORNE RADIOIODINE IN REACTOR CONTAINMENT SYSTEMS. Cejnar, Frantisek (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ., 15: 115-19 (Apr. 1969). (In Czech).

Some questions connected with the behavior of radioiodine vapor released under nuclear reactor accidents are analyzed. Some results related to this problem are presented. (40 references) (auth)

Power Conversion Systems

26063 (CEA-tr-A-1968) PROSPECT FOR THE HELIUM TURBINE FOR A CENTRAL ELECTRIC STATION OF LARGE POWER. Bammert, K. Translated into French from Atomkernenergie, 12: No. 3-4, 141-2(1967). 8p. (In French). Dep.

The development of helium turbines for high temperature gas cooled reactors is discussed. The importance and economics of such turbines are qualitatively evaluated. Cross sections of helium turbines for 330 MW(e) and 1000 MW(e) installations are shown. (M.L.S.)

26064 THE USE OF THE CLOSED-CYCLE HELIUM GAS TURBINE IN ATOMIC POWER PLANTS. Keller, C. Escher Wyss News, 39: No. 1, 40-7(1966).

Design and applications of the closed-cycle gas turbine (CCGT) combined with high temperature gas cooled reactors (HTGR) are discussed. Compared with water reactors and steam turbines the direct-cycle gas system — preferably He — under elevated pressure offers possibilities of lowering capital costs as well as of better fuel economy by higher efficiency. With He as the working medium not only small and medium size plants can be built with present-day technology but also sets up to 250 MW(e) and more can be constructed. Design problems are discussed. (auth)

26065 CO_2-TURBINES IN THE DIRECT AND INDIRECT CYCLE OF NUCLEAR POWER STATIONS. Schabert, H. P. (Siemens AG, Erlangen, Ger.). Brennst.-Waerme-Kraft, 21: 115-19(Mar. 1969). (In German).

CO_2-turbines can be built very compact for the largest unit power ratings. The process efficiency is only very slightly below that of a steam turbine unit if a CO_2 pressure of about 300 atm and compression in the partial streams are applied. This turbine can be used in numerous types of power stations instead of steam turbines. A prerequisite for this is the saving in first costs which so far have not been proved but can be assumed. In contrast to high pressure CO_2 turbines of this type to be used for indirect coupling to reactors, applications of direct CO_2-turbine cycles appear to be very restricted. 6 references. (auth)

Research and Test Reactors

Refer also to abstracts 24426, 24481, 24493, 24864, 25021, 25979, 26018, and 26061.

26066 (AD-678725) MEASUREMENT OF THE TRANSIENT CONTROL ROD MOTION AND ITS EFFECT ON THE AFRRI-TRIGA REACTOR PULSE. Leonard, B. E.; Hughes, D. A. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). June 1968. 24p. (AFRRI-TN-68-6). CFSTI.

The design of a system for the measurement of the transient control rod motion of the AFRRI-TRIGA pulse reactor is presented. Data on the transient rod motion and its effect on the reactor pulse are presented and discussed. It is found that the finite travel time of the rod has an effect on the time of the pulse peak and the magnitude and shape of the pulses above $3.00. For pulses on the order of $1.00, the beginning of the power transient was found to be sensitive to the transient rod bounce. (auth) (USGRDR)

26067 (ANL-7496) TRANTEMP: A CODE FOR CALCULATING TRANSIENT TEMPERATURE DISTRIBUTIONS IN REACTOR HYDRAULIC RABBIT FACILITIES. Kristianson, Bryant N. (Argonne National Lab., Ill.). Nov. 1968. Contract W-31-109-eng-38. 106p. Dep. CFSTI.

Written in FORTRAN for the CDC-3600 computer, the TRANTEMP code solves a set of numerical heat-balance equations. These equations describe the space- and time-dependent temperatures prevailing in a cylindrical, hydraulic rabbit assembly, which is heated by nuclear radiation and cooled by flowing water. Included are the mathematical model, the computer input specifications, a sample problem, and a FORTRAN listing of the code. 4 references. (auth)

26068 (ANL-7510) TIME-OPTIMAL DIGITAL CONTROL OF ZERO-POWER NUCLEAR REACTORS. Marciniak, Thomas J. (Argonne National Lab., Ill.). Oct. 1968. Contract W-31-109-eng-38. 115p. Dep. CFSTI.

Thesis. Submitted to Notre Dame Univ., Ind.

The theory of sampled data control systems, including z-transforms, and discrete state variables are applied in the designed simple, stable, time-optimal, digital control program with general application to zero- or low-power nuclear reactors for power level changes, especially power increases. The program is required to increase power level while maintaining a minimum allowed period, and to reach the demand power level with little, or no, overshoot. To design a stable, time-optimal control system effectively, the stability in the small of a specific error-sampled digital control system was determined for various data holds and sampling intervals for typical fast and thermal reactors. It was found that the zero-order hold was the most stable in most cases for sampling intervals ranging from 0.1 to 5.0 sec. Extensive digital simulation of the digital control program used for ZPR-9 pointed out the need for better period monitoring and a switch-point determination in order to achieve time-optimal control. A time-optimal study using the discrete Maximum Principle was made, with especial emphasis on the terminal control of a one-delayed-group reactor. The ability of a reactor control system to level the power while rising on a period was found to be determined by the maximum rate of reactivity possible. The control program was applied, in digital simulation, to noise-free reactor models with a linear control rod, nonlinear control rod, and to a noisy reactor with a nonlinear control rod. Performance is analyzed. The program was modified for use with ATSR using a DDP-24 computer. Results are presented. 49 references. (auth)

26069 (BNWL-660) FAST FLUX TEST FACILITY. Quarterly Technical Report, January-March 1968. Astley, E. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1969. Contract AT(45-1)-1830. 152p. Dep. CFSTI.

CRITICAL ASSEMBLIES—physics measurements in ZPR-3 Assembly 51, for simulated FTR core
FAST FLUX TEST FACILITY—design and development during January to March 1968
FAST TEST REACTOR—design and development during January to March 1968
—core concepts for, design evaluation of
—loop test specimen conceptual design for
—coolant loss transient analysis for, effects on thermo-hydraulics of
—instrumentation for, description of in-core
—fuel assemblies for, fabrication of pin type
—core of, physics measurements in ZPR-3 Assembly 51 on simulated
—cooling system for, radioisotope transport and deposition in
NEUTRONS, FAST—effects on physical properties of Type 304 and Type 316 stainless steels
REACTOR FUEL ELEMENTS—assemblies of pin type, fabrication of FTR
REACTOR SAFETY—coolant loss conditions in FTR, effects of pipe rupture on
STAINLESS STEEL—radiation effects on physical properties of Type 304 and Type 316, measurement of fast neutrons (D.C.C.)

26070 (BNWL-SA-2215) FFTF INERT GAS SELECTION STUDY. Dulin, R. V.; Foley, C. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 13, 1968. Contract AT(45-1)-1830. 52p. (CONF-690305-3). Dep. CFSTI.

From Remote Handling and Examination in the Fast Reactor Field Meeting, Idaho Falls, Idaho.

Conceptual design of the FFTF includes a range of applications which will require inert gas as a cover gas for liquid metal systems or as an atmosphere in areas where Na-bearing surfaces are exposed to that atmosphere or as a protective atmosphere in enclosures for systems containing radioactive Na. Due to the wide range of applications and their diverse requirements, considerable conceptual study effort was required to select the appropriate gas or gases for each application. The elements of a gas selection study performed in support of conceptual design of the FFTF inert gas systems are presented. (auth)

26071 (DOCKET-50186-1) UNIVERSITY OF MISSOURI RESEARCH REACTOR. Preliminary Hazards Report, Exhibit A. (Missouri Univ., Columbia). Mar. 1961. 262p. Dep. CFSTI.

Information intended to supply sufficient data for the issuance of a construction permit for the proposed pressurized tank-type reactor using highly enriched uranium fuel and cooled and moderated by light water is presented. The reactor would have a flux trap position in the center of the core and control elements located as a shroud surrounding the pressurized tank. The tank would be surrounded by a beryllium and graphite reflector. Proposed initial operation is at a maximum of 5 MW(t), with eventual operation to 10 MW(t). Detailed data are presented on the site, reactor, auxiliary systems and facilities, organization and administration, and an analysis of potential hazards. (H.D.R.)

26072 (DOCKET-50186-9) [UNIVERSITY OF MISSOURI RESEARCH REACTOR]. Facility License No. R-103. (Missouri Univ., Columbia). Oct. 13, 1966. 14p. Dep. CFSTI.

The license authorizing the reactor facility operation at 5 MW(t) is presented. The reactor technical specifications are listed. (H.D.R.)

26073 (DOCKET-50186-10) UNIVERSITY OF MISSOURI RESEARCH REACTOR: TECHNICAL SPECIFICATIONS, CHANGE NO. 1. (Missouri Univ., Columbia). Jan. 25, 1967. 3p. Dep. CFSTI.

Included is the authorization for a change in the core temperature coefficient and a limitation of the absolute reactivity worths of experiments. (H.D.R.)

26074 (DOCKET-50186-11) UNIVERSITY OF MISSOURI RESEARCH REACTOR: TECHNICAL SPECIFICATIONS, CHANGE NO. 2. (Missouri Univ., Columbia). Mar. 14, 1967. 3p. Dep. CFSTI.

Included is the authorization to change the required magnitude of the negative core void coefficient. (H.D.R.)

26075 (DOCKET-50186-12) UNIVERSITY OF MISSOURI RESEARCH REACTOR: TECHNICAL SPECIFICATIONS, CHANGE NO. 3. (Missouri Univ., Columbia). July 11, 1967. 10p. Dep. CFSTI.

An authorization for changes in the operation of the continuous fuel failure monitor, the minimum count rate on the neutron monitor prior to startup, the maximum allowable pressure drop across the reflector with forced pool flow, and coolant conditions during natural convection operation is presented. (H.D.R.)

26076 (DOCKET-50186-13) UNIVERSITY OF MISSOURI RESEARCH REACTOR: TECHNICAL SPECIFICATIONS, CHANGE NO. 4. (Missouri Univ., Columbia). Aug. 12, 1968. 4p. Dep. CFSTI.

Included is an authorization to increase the allowable average fuel burnup per element. (H.D.R.)

26077 (DOCKET-50186-14) [UNIVERSITY OF MISSOURI RESEARCH REACTOR]. Facility License No. R-103, Amendment 1. (Missouri Univ., Columbia). Apr. 23, 1968. 7p. Dep. CFSTI.

The facility license is amended to increase the amount of contained ^{235}U the University is authorized to receive, possess, and use. (H.D.R.)

26078 (EUR-3940-1) RESEARCH AT ISPRA, 1961-1967. PART I. PHYSICS. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1968. 258p. UK $6.00.

A review of the research work performed at the Euratom research laboratory at Ispra, Italy, is presented for 1961 to

1967. Information covered in the review includes work performed in physics under the following headings: reactor physics; nuclear facilities for research on reactor and neutron physics; preparation for the SORA Reactor; neutron physics; nuclear chemistry laboratory contribution to nuclear detection; radio-frequency spectroscopy of matter; solid state physics; and information treatment. Separate abstracts are included for each of the 8 sections presented. (D.C.C.)

For abstracts of individual sections see: 24458, 25426, 25427, 26079–26082, and 26108.

26079 (EUR-3940-1, pp 27-52) NUCLEAR FACILITIES FOR RESEARCH ON REACTOR AND NEUTRON PHYSICS. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center).

Descriptions of the four facilities at the research laboratory at Ispra, Italy, are presented. The facilities described include: ISPRA-1, a SMW heavy water reactor; ECO, a heavy water critical assembly; EXPO, a heavy water exponential facility; and the RB-1 heavy water facility. (D.C.C.)

26080 (EUR-3940-1, pp 53-81) PREPARATION FOR THE SORA REACTOR. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center).

A description of the SORA reactor and its experimental facilities is presented. Neutron physics experiments performed in the reactor are described. 36 references. (D.C.C.)

26081 (EUR-3940-1, pp 85-128) NEUTRON PHYSICS. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center).

The experimental facilities of the ISPRA-1 reactor are described. Research studies in the fields of static and dynamic structure of condensed matter and thermal and fast neutron spectra in non-multiplying media are reviewed. 48 references. (D.C.C.)

26082 (EUR-3940-1, pp 199-251) INFORMATION TREATMENT. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center).

A description of the organization and operation of the CETIS information center is presented. 155 references. (D.C.C.)

26083 (GEAP-5467) SEFOR FUEL ROD SODIUM THERMAL SHOCK TESTS. Cochran, J. T. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Aug. 1968. Contract AT(04-3)-540. 70p. Dep. CFSTI.

Results of thermal shock experiments with model fuel and extension rods of the type proposed for use in the SEFOR core are presented. The fuel elements for SEFOR were mixed PuO_2-UO_2. The coolant for SEFOR is liquid Na. The model fuel and extension rods were subjected to rapid Na temperature variations of the order of 500°F per second. After 56 500°F thermal shocks of 800° to 1300°F, the dummy fuel and extension rods were inspected. Results are presented. (D.C.C.)

26084 (GEAP-5468) AN IN-PILE EVALUATION OF W-Re THERMOCOUPLE SYSTEMS FOR USE TO 4700°F IN SEFOR FUEL. Novak, P. E.; Asamoto, R. R. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Oct. 1968. Contract AT(04-3)-540. 86p. Dep. CFSTI.

In-pile tests were conducted to develop reliable W–Re thermocouple systems capable of measuring fuel temperatures up to 4700°F in the Southwest Experimental Fast Oxide Reactor (SEFOR). Results showed that W5Re/W26Re thermocouples can be expected to decalibrate less than 45°F at 800°F and less than 10°F at 3000°F after their full design life of 1800 hours in the SEFOR core. Both BeO and ThO_2 insulated thermocouples operated satisfactorily for over 1200 hours in-pile at temperatures in excess of 4200°F. BeO will be used as thermocouple insulation for the majority of the SEFOR fuel thermocouples while ThO_2 will be used in locations where fuel temperatures are expected to exceed the melting point of the BeO. Bare wire, $\frac{1}{16}$-inch (sheath diameter) W26Re sheathed thermocouples, and $\frac{1}{8}$-inch (sheath diameter) W26Re sheathed thermocouples operated satisfactorily in-pile under both steady state and transient conditions which are representative of those expected in SEFOR. 15 references. (auth)

26085 (GEAP-5705) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR DEVELOPMENT PROGRAM. Eighteenth Quarterly Report, August–October 1968. Pflasterer, G. R. (comp.) (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Nov. 1968. Contract AT(04-3)-540. 34p. Dep. CFSTI.

Development of a suitable detector system for recording the transient flux during SEFOR experimental programs is described. The FRED reactivity excursion device is also described. A description of fuel rod fabrication and associated core components for SEFOR is included. The SEFOR startup testing and transient testing programs are reviewed. Operations and construction tasks completed during August to October 1968 are listed. (D.C.C.)

26086 (IN-1218, pp 1-56) NEUTRON INTERACTIONS WITH NUCLEI. (Idaho Nuclear Corp., Idaho Falls).

ALUMINUM — reactivity worth of, comparison of measured and calculated values for
ALUMINUM OXIDES — neutron total cross section for, use in MTR of powdered sample technique for measuring thermal
AMERICIUM ISOTOPES AM-243 — neutron capture by, thermal activation cross section and resonance activation integral for
— gamma energies for isomeric, measurement in MTR of
ANTIMONY — neutron resonance integral for, variation with temperature of the relative effective
BERYLLIUM — reactivity worth of, comparison of measured and calculated values for
BISMUTH — reactivity worth of, comparison of measured and calculated values for
CARBON — reactivity worth of, comparison of measured and calculated values for
HAFNIUM — reactivity worth of, measurement in MTR of radiation effects on changes of
— neutron resonance absorption integral for, use of static reactivity technique for measuring infinite dilution
HELIUM ISOTOPES HE-3 — reactivity worth of, comparison of measured and calculated values for
IODINE ISOTOPES I-135 — neutron fission yields relative to uranium-235
LEAD — neutron total cross section for, use in MTR of powdered sample technique for measuring thermal
— reactivity worth of, comparison of measured and calculated values for
MAGNESIUM — reactivity worth of, comparison of measured and calculated values for
MATERIALS TESTING REACTOR — neutron cross section variation measurements in, use of manganese bath technique for
— test facilities for, use of scandium collimator for production of gamma-free beam in HB-3
— hafnium burnup measurements in, reactivity worth variations during
NEPTUNIUM ISOTOPES Np-237 — neutron capture by, thermal activation cross section and resonance activation integral for
— gamma energies for isomeric, measurement in MTR of
NEUTRON CROSS SECTIONS — fitting of, description of peak and shape
— measurement of fissile material scattering, description of linear accelerator experiment for
— variations in, use of manganese bath technique in MTR for measuring
NEUTRONS — reactions with plutonium-241, η value for
NEUTRONS, FISSION — reactions with plutonium-238, resonance parameter determination using area analysis technique
PLUTONIUM ISOTOPES Pu-238 — neutron fission data for, use of area analysis technique for analysis of resonances below 500 eV in
— neutron resonance parameters for, tabulation of
PLUTONIUM ISOTOPES Pu-239 — neutron cross section variations in, use of manganese bath technique in MTR for measuring
— neutron elastic scattering cross sections for, from 1 to 200 eV
PLUTONIUM ISOTOPES Pu-241 — eta measurements for, use of scandium-collimated 0.0235 eV neutron beam from MTR for
— neutron total cross section for, measurement in MTR from 0.02 to 0.1 eV of
PLUTONIUM ISOTOPES Pu-242 — neutron total cross section measurement in MTR of, from 0.008 to 8000 eV
— neutron resonance parameters for
— neutron total cross section for, use in MTR of powdered sample technique for measuring thermal
PROMETHIUM ISOTOPES Pm-147 — neutron resonance parameters for, description of computer program for determining
— neutron total cross section for, time-of-flight neutron measurements in MTR of
REACTIVITY — worth calculations for small samples of reactor materials
REACTOR FUEL ELEMENTS — reactivity worth of uranium dioxide (UO_2)–zirconium oxide (ZrO) ternary ceramic pellet, measurement of temperature dependent
TANTALUM ISOTOPES Ta-182 — neutron total cross section for, measurement in MTR from 0.01 to 1000 eV of

TECHNETIUM ISOTOPES Tc-99—neutron total cross section for, from 0.01 to 1000 eV
THALLIUM ISOTOPES Tl-204—neutron total cross section for, measurement from 0.02 to 1000 eV in MTR of
THORIUM OXIDES ThO_2—neutron total cross section for, use in MTR of powdered sample technique for measuring thermal
URANIUM ISOTOPES U-233—neutron elastic scattering cross sections for, from 1 to 200 eV
URANIUM ISOTOPES U-235—neutron cross section variations in, use of manganese bath technique in MTR for measuring —neutron elastic scattering cross sections for, from 1 to 200 eV
WATER-d—reactivity worth of, comparison of calculated and measured values of
WATER d_2—reactivity worth of, comparison of measured and calculated values for
ZIRCONIUM—reactivity worth of, comparison of measured and calculated values for (M.L.S.)

26087 (JAERI-1175) STUDY OF THE FUEL CLADDING FAILURES IN JRR-2. Takayanagi, Hiroshi (ed.) (Japan Atomic Energy Research Inst., Tokyo). Mar. 1969. 28p. Dep.

The JRR-2 reactor uses MTR type fuel elements, which had never failed before 1966. In August 1966, however, water in the spent fuel storage pond indicated an abnormal increase in activity when two fuel elements were transferred from the reactor core into the pond. The results of the investigation to determine the causes of fuel failures are presented. The results are summarized. 17 references. (auth)

26088 (KURRI-TR-11) LOG OF INTERIOR RADIOACTIVITY MONITORING. PART II. Katsurayama, Yukinori; Hayashi, Fumikazu; Sumino, Teruie; (and others) (Kyoto Univ. (Japan). Research Reactor Inst.). 1965. 32p. (In Japanese). Dep.

A record of the radiation monitoring program for the Kyoto University Research Reactor for the year 1965 is presented. The measurements include determination of dose rates, cumulative doses, surface contamination concentrations, radioactivity of waste water, radioactive dust accumulations, and radioactive gas concentrations. During 1965, the reactor was changed from experimental to steady state operation, resulting in an increased use of hot laboratories and monitoring areas. Data on surface contamination in the laboratories, activity of the waste water from the research buildings, radioactive dust released from the stack, and radioactive gas concentration revealed no unusual incidents. (TTT)

26089 (LA-DC-10055) DISPOSABLE CORE FAST BURST REACTORS. King, L. D. P. (Los Alamos Scientific Lab., N. Mex.). [1968]. Contract W-7405-eng-36. 19p. (CONF-690102-5). Dep. CFSTI.

From Fast Burst Reactor National Topical Meeting, Albuquerque, N. Mex.

A possible means for producing very large fast neutron bursts appears feasible through the use of a mobile fuel in an undefined geometry. The fuel is dispersed by internal energy into a large cavity for reuse without damage to the main facility. A study of such a potential system has been made using a design concept designated Liquid Excursion Pulsed Reactor (LEPR). Calculations and preliminary experiments for such a system when using uranyl sulfate fuel solution are analyzed. Burst intensities of 10^{19} to 10^{20} may be possible with minimum pulse widths at half maximum of 35 μsec. Two schematic designs are illustrated. 17 references. (auth)

26090 (NP-tr-1755) REACTOR WATER PROBE. Zajic, Vladimir. Translated by M. Backer (Atomic Energy Research Establishment, Harwell, Eng.), from Jad. Energ., 13: 1-3(1967). 10p. Dep.

The construction and operation of a water filled probe for investigations of the radiation resistance of corrosion inhibitors are described. Use of the probe in static experiments on water corrosion of steel and corrosion inhibition in the radiation field of a VVR-S reactor is discussed. (H.D.R.)

26091 (ORNL-CDC-5) MINIMUM CRITICAL ^{235}U ENRICHMENT OF HOMOGENEOUS HYDROGENOUS URANYL NITRATE. Bierman, S. R.; Hess, G. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 1968. Contract W-7405-eng-26. 34p. Dep. CFSTI.

For Oak Ridge National Lab., Tenn.

A series of experiments with 2.14 and 2.26 wt % ^{235}U-enriched uranyl nitrate was performed in the Physical Constants Test Reactor to determine the minimum critical ^{235}U enrichment for homogeneous hydrogenous uranyl nitrate and to observe the reactivity effect of neutron moderation on these low enriched uranium materials. The minimum critical enrichment was determined to be 2.104 ± 0.010 wt % ^{235}U at an optimum H:U atomic ratio of 7.6. Optimum neutron moderation occurred, with k_∞ values of 1.013 and 1.04, at H:U atomic ratios of 8.0 ± 1.0 and 9.3 ± 0.5, respectively, for the 2.14 and 2.26 wt % enriched uranyl nitrate. Values of k_∞ greater than unity were observed for H:U ratios between 6 and 10.5 for the 2.14 wt % enrichment and between 4 and 15 for the 2.26 wt % enrichment. (auth)

26092 (RT/FI-(68)35) THE OSCILLATION METHOD FOR MEASUREMENT OF THE FISSION AND ABSORPTION CROSS SECTIONS IN THE REACTORS RANA AND RITMO. Santandrea, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 26p. (In Italian). Dep.

Use of oscillation methods for determining core neutronic characteristics is discussed. Perturbed neutron flux equations, which allow macroscopic cross section determination, are given. The experimental apparatus, instrumentation and configuration for the RANA and RITMO assemblies are described; equations for experimentally determined quantities are given. General design characteristics of the oscillator at RITMO are listed. (M.L.S.)

26093 (TUBIK-10) DETERMINATION OF THE THERMAL SPECTRUM OF THE SUR 100 BE WITH A NEUTRON CHOPPER. Bartsch, G.; Klose, W.; Wesser, U. (Technische Universitaet, Berlin (West Germany). Institut fuer Kerntechnik). Sept. 1968. 95p. (In German). Dep.

Use of a neutron chopper to measure the thermal neutron spectrum in the SUR 100 BE reactor is described. Correction factors used in the time-of-flight measurements are discussed. The construction of the chopper outlined; the experiment arrangement is shown schematically. Measurement techniques, data acquisition and processing, and error analyses are detailed. Results of the chopper measurements are given; data are presented graphically and tabularly. 26 references. (M.L.S.)

26094 CONSTRUCTION OF AN EXPERIMENTAL LOOP. Martinek, J.; Mlynarik, J.; Novotny, K. Skoda Rev., No. 6, 53-6(1968).

Design parameters for an in-pile loop in the Czechoslovakia research reactor are described. Flow diagrams for the CO_2 loop are presented. (D.C.C.)

26095 NUCLEAR REACTORS IN THE SOVIET UNION. Lavrencic, D. Com. Naz. Energ. Nucl., Notiz., 15: No. 3, 62-73(Mar. 1969). (In Italian).

A survey of the reactors in the Soviet Union is given. Design parameters, rated power, and criticality dates are tabulated for: research reactors, thermal power reactors, and fast reactors. Longitudinal cross sections of the research reactors TVR, VVR-2, IVV-2, SM-2, MR, MIR, and IGR are shown; core cross sections are shown for the IRT, VVR-M, and SM-2. Each reactor is discussed separately. (M.L.S.)

26096 STUDIES ON THE RECYCLING OF PLUTONIUM IN THE RITMO REACTOR AT CASACCIA. Santandrea, Emilio (CSN, Casaccia, Italy). Com. Naz. Energ. Nucl., Notiz., 15: No. 3, 41-52(Mar. 1969). (In Italian).

A description of the RITMO reactor is given; design parameters for the core and fuel elements are tabulated. Core nuclear constants and characteristics are listed; fast and thermal neutron flux distributions are shown for rods withdrawn and inserted. Spectral indices are given for the plutonium zone. (M.L.S.)

26097 PRODUCTION AND COLLECTION OF ^{41}Ar UNDER NORMAL 1 MW OPERATING CONDITIONS OF THE RC-1 REACTOR AT C.S.N. CASSACIA. Verri, A. Ing. Nucl., 9: No. 5, 23-31(Sept.-Oct. 1968). (In Italian).

A general description of the RC-1 research reactor at Cassacia is given. Areas where ^{41}A is produced are tabulated; the equations used for quantitative determination of production of ^{41}A are given. Neutron fluxes and ^{41}A production are tabulated for each of the test facilities. Removal of the air from the test facilities and other channels is described. (M.L.S.)

26098 SAFETY-RELATED OCCURRENCES REPORTED IN DECEMBER 1968–JANUARY 1969. Cramer, E. N. (comp.). Nucl. Safety, 10: 250-3(May-June 1969).

Of some 150 items of operations reports and licensing correspondence pertaining to operating facilities received at the AEC Public Document Room and the NSIC in December 1968 and January 1969, nine are described. 16 references. (auth)

26099 EXPERIENCE WITH CONTAINMENT PENETRATIONS AT THE PLUM BROOK REACTOR FACILITY. Conant, C. W. Nucl. Safety, 10: 243-8(May-June 1969).

The penetration-monitoring system was installed at the Plum Brook Reactor Facility to monitor the leakage of all containment-

vessel penetrations. Leak-rate tests revealed that the original potted electrical penetrations were a major contributor to the leakage of the containment vessel. Hermetically sealed penetrations were therefore developed to replace the potted penetrations, and the resultant leakage rate through the modified electrical penetrations was reduced to a total of less than 0.06 cu ft/day, or 0.015% of the allowable rate. 5 references. (auth)

26100 SELF-LIMITING POWER EXCURSION CHARACTERISTICS OF LIGHT WATER REACTOR. II. ANALYSIS OF DOPPLER LIMITED POWER BURST. Kato, Hidemasa; Imai, Munemaro (Hitachi Ltd., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 6: 215-20(Apr. 1969).

The power excursion characteristics of a water-moderated UO_2 fuel reactor were investigated by pulse operation tests on the Hitachi Training Reactor. A series of pulse operation tests were performed without mishap with reactivity insertions up to 1.20% $\Delta k/k$, corresponding to a reactor period of 15 msec. With a reactivity insertion of 1.20% $\Delta k/k$, the peak power and energy release to the time of peak power were found to be restricted by the Doppler effect to 118 MW and 4.1 MW·sec respectively. Comparisons were made between experimental and calculated values of peak power and energy for various published resonance integral temperature coefficients. (11 references) (auth)

Rocket and Space Reactors

26101 THE VORTEX GAS CORE NUCLEAR ROCKET: A BINARY DIFFUSION MODEL, WITH APPLICATIONS. Dupree, Stephen Allen. Lafayette, Ind., Purdue Univ., 1968. 212p. Thesis.

A brief review of gas core nuclear rocket research is given, with particular emphasis on vortex designs. An engine is proposed which utilizes fuel ionization and a magnetic mirror to attempt to enhance the containment of fuel in the core region of the vortex core design. To facilitate analysis of the proposed device, a model for describing binary diffusion in a confined vortex flow, including the approximate treatment of three-dimensional effects and the allowance for magnetic force, is developed. The accuracy of the model is tested against the results of two binary diffusion experiments and found to be reasonable within the range of applications considered. The theoretical results are found to depend strongly on the level of turbulence and on the value of the binary diffusion coefficient. The analysis of the proposed device shows that the magnetic fuel containment mechanism will not be effective under practical conditions. (Diss. Abstr.)

Process Heat and Desalination Reactors

26102 FACTORS AND UNCERTAINTIES OF THE FEASIBILITY OF RESORTING TO NUCLEAR ENERGY IN WATER DESALTING. Thiriet, L.; Lievre, P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris), No. 134, 51-8(Feb. 1969). (In French).

The different kinds of uncertainties linked to technical, economic and financial data (different transmission coefficients, length of life of the materials according to the choice of the latter, the evolution of prices, the form of price functions and the rates of interest) and to constraints in the use of nuclear desalting are described. The uncertainties linked to the method of optimization used are discussed. 4 references. (auth)

Marine and Portable Power Reactors

26103 FLUID DYNAMIC STABILITY IN HEAT EXCHANGERS FOR NUCLEAR PLANTS. D'Urso, Carlo; Jacovoni, Franco; Secolo, Nunzio. Termotecnica (Milan), 22: 497-504; 517(Nov. 1968). (In Italian).

A brief description of the functioning of steam generators in nuclear plants is given; effects of instabilities in the steam generator functioning are considered. The performance of steam generators with naval reactors is evaluated; principal characteristics of the generators are listed. Results of the performance analysis are shown graphically; damping coefficients are tabulated. Margins of stability are shown. (M.L.S.)

26104 DATA SHEETS ON REACTOR CONTROL: ADVANCED PRESSURE WATER REACTOR (FDR). Brennst.-Waerme-Kraft, 21: 140-1(Mar. 1969). (In German).

Operation parameters for control of the Otto Hahn Reactor are listed. (D.C.C.)

26105 BOILING WATER REACTORS AS SHIP PROPULSION. Engel, H.; Traube, K. (AEG-Telefunken, Frankfurt am Main). Atomkernenergie, 14: 150-6(May-June 1969). (In German).

In the early days of reactor development boiling water reactors (BWR) as ship propulsion units were not considered, because problems such as radioactivity in primary steam and dynamic behavior of boiling nuclear systems were anticipated. Especially in connection with ship movements difficulties were expected. Experience shows, however, that the BWR is well qualified as a ship propulsion unit. The development of internal recirculation pumps and internal steam-water-separators in connection with direct steam cycle allows a very compact reactor arrangement. A discussion of the main experience with BWR and a short description of a BWR-ship propulsion system are presented. (auth)

26106 TRANSPORT COSTS AND OPTIMAL SPEED FOR A BULK-CARRIER, AND THE INFLUENCE ON THESE BY THE COST OF FUEL, THE LAY-DAYS IN PORT, AND THE SERVICE OF CAPITAL. Paul, Hans-George. Atomkernenergie, 14: 198-206(May-June 1969). (In German).

When designing or planning a ship the answering of questions concerning the employment of nuclear power plants and, at the same time, their correct size or capacity, is facilitated by numerical data concerning economic considerations. Optimum design and operating criteria are analyzed. (6 references) (auth)

Production Reactors

Refer to abstract 24813.

Reactor Theory

Refer also to abstract 26081.

26107 (BNWL-SA-2164) STRATEGY AND TECHNIQUES FOR SOLVING THE TWO-DIMENSIONAL MULTIGROUP DIFFUSION EQUATION. Hardie, R. W.; Little, W. W. Jr. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 1, 1968. Contract AT(45-1)-1830. 5p. (CONF-690401-2). Dep. CFSTI.

From Conference on the Effective Use of Computers in the Nuclear Industry, Knoxville, Tenn.

Techniques for solving the spatial flux in fast reactor multigroup diffusion equations are described. Use of line inversion with tight mesh spacing for obtaining group-flux profiles is discussed. Effects of the various acceleration schemes on computer time are tabulated. (M.L.S.)

26108 (EUR-3940-1, pp 3-25) REACTOR PHYSICS. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center).

A review of the reactor physics work completed at the research laboratory at Ispra, Italy, is presented. Topics discussed include: PINOCCHIO lattice calculation code for thermal reactors; ^{240}Pu resonance absorption analysis; the Nelkin–Ardente model for slow neutron scattering in polyphenyls; ^{238}U resonance neutron capture measurements; ^{238}U fast fission measurements; fine structure of the thermal neutron flux and thermal spectrum index distribution in complex-geometry fuel elements; Fermi age measurements in organic compounds; the COSTANZA series of codes; SABINE one-dimensional shielding program; neutron transport studies by the j_n and Monte Carlo method; and statistical methods and Monte Carlo development. 34 references. (D.C.C.)

26109 (FEI-142) REACTIVITY INTEGRALS AND THEIR USE FOR THE SOLUTION OF CERTAIN PROBLEMS IN REACTOR PHYSICS. Stumbur, E. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1968. 51p. (In Russian). Dep.

The work sets forth the concept of integrals involving reactivity, specific functionals of solutions to the Boltzmann kinetic equation, which are simply connected with the k_{eff} of an arbitrary geometry reactor. Invariant integral relations are established for the Boltzmann equation in the case of critical and noncritical systems. The "method of compensated perturbations," which results in a variation equation for the integrals involving reactivity is introduced. The developed theory is used to solve some problems in reactor physics having to do with the interdependence of the critical size and composition of a reactor or the reflector size, etc. Some contrasts of theoretical results and experimental data are discussed. The work considers further possibilities for de-

veloping the methods here set forth in order to solve other problems in reactor physics. (tr-auth) (JPRS)

26110 (JEN-196-DF/I-60) STUDY OF RESONANCE ABSORPTION IN HOMOGENEOUS NUCLEAR REACTORS. de Francisco Sainz, J. L. (Junta de Energia Nuclear, Madrid (Spain)). 1967. 167p. (In Spanish). Dep.

The physics of neutron moderation and resonance absorption is outlined. Effective resonance cross sections are defined mathematically; the Breit-Wigner formulation is discussed. A discussion of neutron moderation in homogeneous media is detailed; solutions for the neutron moderation equations are included. Resonance integrals are developed for homogeneous media; methods for approximating resonance integrals are detailed. The Doppler effect and its physical interpretation are discussed. Results of numerical integration of resonance equations are given; data are included in tabular form. The methods developed for homogeneous media are extended to heterogeneous media. (M.L.S.)

26111 (KFK-716) A FORTRAN PROGRAM FOR CALCULATION OF THE THERMODYNAMIC CYCLE AND THE COOLING CYCLE OF A STEAM COOLED NUCLEAR REACTOR. Spilker, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Dec. 1967. 107p. (In German). (EUR-3727). Dep.

A short description of the heating circuits for steam cooled reactors is given; flow diagrams are shown for direct and indirect cycles. Determination of expansion curves is discussed; heat balance and mixture balance equations are given for the cooling cycle. The overall organization of a computer program for calculating thermodynamic quantities is described; detailed flow diagrams are included. Input/output format is given; subroutines are described. A sample problem is included. The program is written in FORTRAN for the IBM 7074. (M.L.S.)

26112 (KFK-725) PRAWDA: A FORTRAN PROGRAM FOR PYROMETRIC INTERPRETATION OF STEAM- AND GAS-COOLED REACTORS. Doetschmann, K.; Hofmann, F.; Kirsch, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Aug. 1968. 57p. (In German). (EUR-3974). Dep.

The calculational bases and assumptions for the PRAWDA program are given; the equations used in the program are listed. The following calculational capabilities are discussed: coolant channel geometry, enthalpy balances for individual sectors, and reactor heat transfer with turbulence. Flow diagrams, input/output format, and a sample program with subroutines are included. The program is written in FORTRAN for the IBM 7094. (M.L.S.)

26113 (KFK-759) STABILITY PROBLEMS OF A STEAM-COOLED FAST REACTOR. Frisch, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Apr. 1968. 96p. (In German). (EUR-3730). Dep.

Dynamic behavior of a steam cooled reactor is analyzed in detail. Monotonic and oscillator instabilities are discussed. Linear models and methods for stability analyses are described; nonlinear stability analysis methods, with and without delayed neutrons, are detailed. Nonlinear behavior of a one-dimensional core with monotonic instabilities is analyzed. Effects of the steam cycle on reactor stability are considered. 23 references. (M.L.S.)

26114 (WAPD-TM-822) EMPIR: A PROGRAM TO SOLVE THE MULTI-GROUP SLAB TRANSPORT PROBLEM USING THE ENDF/B LIBRARY. Butler, J. D.; Gelbard, E. M.; Schmidt, E. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Mar. 1969. Contract AT(11-1)-Gen-14. 38p. Dep. CFSTI.

EMPIR (BE22) solves the neutron transport problem with slowing down in slab geometry by using the ENDF/B library for all material cross sections of interest. The slowing down description is provided by a matrix formulation of scattering coefficients, while the spatial solutions for the flux in each group are obtained from a discrete ordinate approximation. Program BD03 is a related special program to obtain fine detail spectra for simply buckled media. 10 references. (auth)

26115 SET OF FUNCTIONS FOR TIME AND ENERGY DEPENDENT THERMALISATION PROBLEMS. von Baltz, Ralph (Univ., Karlsruhe, Ger.). Atomkernenergie, 14: 179-81(May-June 1969). (In German).

The expansion of the time and energy dependent neutron flux in terms of a new orthonormal set of functions shows excellent convergence properties. This basis transfers the Heavy Gas Thermalization Operator into a Jacobian matrix. (7 references) (auth)

26116 ABOUT THE OPTIMIZATION OF CONTROL PROCESS IN A NUCLEAR REACTOR. Sultan, M. A. (IAEA, Vienna). Atomkernenergie, 14: 221(May-June 1969).

A simple algorithm for optimal reactor control is derived using classical calculus of variation. (auth)

26117 NEUTRON TRANSPORT IN MONOENERGETIC CRITICAL CONFIGURATIONS WITH FINITE REFLECTORS. I. SLABS. Leuthaeuser, Klaus-Dieter (Univ., Kiel). Atomkernenergie, 14: 173-9(May-June 1969).

The singular eigenfunction expansion method developed by K. M. Case is applied to monoenergetic multiplying slabs with finite reflectors. The system of singular integral equations for the continuum coefficients resulting from the boundary conditions can be decoupled on assuming that the reflector is a "wide" region. One of the singular equations is that of the Milne problem and can be solved explicitly, the other can be reduced by Muskhelishvili's procedure to a Fredholm integral equation with regular kernel. In consequence to the completeness of the eigenfunction expansion, an additional condition of criticality has to be satisfied. By simultaneous numerical iteration of the Fredholm equation and the criticality condition, the critical dimensions of the core are determined for a given reflector thickness. The range of applicability of the iteration scheme and the "wide-region" approximation for the reflector are discussed. (11 references) (auth)

26118 WAVE PROPERTIES OF LINEAR TRANSPORT. Mueller, K.-H. (CCR EURATOM, Ispra, Italy). Atomkernenergie, 14: 171-3(May-June 1969).

The particle distribution function satisfies a transport equation governing the local behavior of a system of a large number of equal structured particles interacting with a "reactor." After an average over the velocity space, the distribution function becomes easier to handle mathematically, but involves certain properties generated by the averaging procedure. (9 references) (auth)

26119 PARTICULAR SOLUTIONS OF THE UNHOMOGENEOUS, ONE-VELOCITY BOLTZMANN EQUATION IN PLANE GEOMETRY. Freund, Hans-Dieter (Univ., Kiel). Atomkernenergie, 14: 222(May-June 1969).

Experimental Applications

Refer also to abstract 25761.

26120 (CEA-tr-A-1952) PREVENTION OF CRITICALITY ACCIDENTS. Schueller, W.; Zuend, H. Translated into French from Atompraxis, 12: 47-50(1966). 16p. (In French). Dep.

The handling of fissile material outside a reactor is discussed; storage and movement are considered. Criticality control by: safe geometry; concentration, moderation, and enrichment; control of mass; and neutron poisons. Safety practices of the Eurochemic reprocessing installation are described. (M.L.S.)

26121 (IN-1218, pp 57-72) NEUTRON INTERACTIONS WITH ATOMS. (Idaho Nuclear Corp., Idaho Falls).

BORIC ACID—neutron absorption cross section effects on reactivity changes in light and heavy water solutions of
NEUTRON CROSS SECTIONS—calculation of resonance absorption, validity of effective temperature and Debye spectrum approximation in (T)
NEUTRONS—pulse width measurements for reactor moderators, use of linear accelerator for
—time distributions in reactor moderators, calculation of
NEUTRONS, FAST—absorption of, effects of chemical binding on Doppler widths of resonance, (T)
REACTIVITY—neutron scattering effects on, use of light and heavy water solutions of boric acid for measuring
REACTOR MODERATORS—neutron pulse widths for, use of linear accelerator for experimental determination of
—neutron time distributions for, calculation of
WATER—neutron absorption cross section effects on reactivity changes in boric acid solutions of
WATER-d_2—neutron absorption cross section effects on reactivity changes in boric acid solutions of (M.L.S.)

26122 (RT/FI-(68)41) ANALYSIS OF THE PROPAGATION AND PERTURBATION OF ABSORPTION AND FISSION IN A MULTIPLYING LATTICE. Musco, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 26p. (In Italian). Dep.

An analysis is made of the propagation of periodical absorption and fission perturbations within a multiplying lattice, placed in the central cavity of the RITMO reactor, for the purpose of determining the optimum position of the detectors used for the oscillation measurements of the central fuel rod. (auth)

26123 AVAILABLE INFORMATION ON THE DENSITY OF TWO PHASE MIXTURES USED AS NUCLEAR REACTOR COOLANTS. Agostini, G. (CISE, Milan); Hassid, A.; Premoli, A. Termotecnica (Milan), 23: 69-78(Feb. 1969). (In Italian).

A brief review is presented of experimental data and theoretical approach for the determination of two-phase mixture density and void fraction: the study concerns mainly the density, which is the quantity directly interesting the behavior of nuclear reactors cooled and/or moderated by two-phase mixtures. Results, obtained at CISE and other laboratories, are analyzed and the effects are discussed of the main physical parameters governing the values of mixture density, under adiabatic and heated conditions as well in subcooled and saturated region. Moreover a critical survey of some theoretical models and empirical correlations for density calculation is presented. (26 references) (auth)

26124 TRANSIENT HEAT TRANSFER IN MODEL OF A REACTOR CHANNEL. Feretic, D. (Institute Djuro Djakovic, Zagreb). Atomkernenergie, 14: 157-62(May-June 1969).

Transient heat transfer in an apparatus representing a model of reactor channel has been studied theoretically and experimentally. Theoretical analysis consisted in exact treatment of the relative partial differential equations by the Laplace transform method. These equations were then transformed into the frequency domain and programmed for an IBM-1620 digital computer. An additional computer program was prepared to transform the frequency response data into the step response data. The experiments were performed by measuring the responses of the coolant outlet temperature from the channel and the heater surface temperature to step changes of the electrical power imposed to the heater. It was found that the agreement between experimental and theoretical results is satisfactory. (18 references) (auth)

26125 FAST METHODS FOR COMPUTING THERMAL-NEUTRON GROUP CONSTANTS IN SINGLE-PIN LATTICE CELLS. Stamm'ler, Rudolf Johannes Jacobus. Delft, Netherlands, Technische Hogeschool, 1968. 63p.

Thesis.

A description of the computer program K-7 THERMOS is presented. The program is a multishell, multigroup solution of the integral transport equation. The comparison of K-7 THERMOS results with experimental data is described. Fast methods for evaluating thermal-group constants in three-region cells are presented. The computer programs are listed as AMCLA, DATAPREP-2, and SATAN. A comparison of these fast programs with the K-7 THERMOS program is described. (46 references) (D.C.C.)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 24253, 24343, 24344, 24348, 24355–24357, 24362, 24392, 24405, 24449, 24475, 24494, 24784, 24794, 24812, 24815, 24845–24847, 24851, 24855, 24860, 24861, 24871, 24872, 24959, 24960, 24963, 24967, 24973, 24982, 24985, 24998, 25006, 25020, and 26018.

26126 (AAEC/TM-498) ANALOGUE COMPUTER MODEL OF A RESEARCH REACTOR FOR TEACHING THE FUNDAMENTALS OF REACTOR CONTROL AND ANALYSIS. Corran, E. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr. 1969. 30p. Dep.

An analogue computer model of a research reactor is described which includes neutron kinetics, thermodynamics, Xe poisoning and control features. The model makes provision for optimizing the control system and for compressing the time scales by factors of one thousand and ten thousand to demonstrate xenon dynamics. Recorder traces showing some of the basic behavior of the model are included. (auth)

26127 (HPR-107) IN-CORE STUDY OF FUEL/CLAD INTERACTION AND FUEL CENTRE TEMPERATURE. Kjaerheim, G.; Rolstad, E. (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). Jan. 1969. 36p. Dep.

Differential transformers and tungsten–rhenium alloyed thermocouples have been used extensively to study the thermal and dimensional behaviour of fuel rods under irradiation. The differential transformers have been used to measure fuel and cladding length changes. The results have also provided a considerable amount of information on diametral fuel expansion. Permanent dimensional changes have been observed, both in the diametral and axial direction. A mechanism for ridge formation has been proposed, taking into account both the hourglass shape of the pellets, frictional forces and the axial forces working between the pellets. Local axial and hoop strain concentrations are judged, under certain circumstances, to represent a serious hazard to cladding integrity. Measurements have been made on rods containing both flat and dished sintered UO_2 pellets and vibratorily compacted fuel. The thermocouples have been used to measure center fuel temperatures of sintered UO_2, mixed ThO_2–UO_2 and vibratorily compacted UO_2. Most of the data are obtained on new fuel, but a few results are also available after a considerable burnup. The measured center fuel temperatures have been used to determine thermal conductivity data for sintered and pelletized UO_2 and mixed ThO_2–UO_2. The UO_2 data are valid to 2150°C, whereas the data for mixed oxide extend to 1700°C with some basis for extrapolating to 1900°C. The effects of density and fuel/cladding gap on the center fuel temperature have been studied. 11 references. (auth)

26128 (JUL-552-RW) TECHNOLOGICAL PROPERTIES OF BERYLLIUM OXIDE-MODERATOR ELEMENT FOR A THERMAL HIGH TEMPERATURE REACTOR OF THE PEBBLE BED TYPE. Buresch, F. E. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Sept. 1968. 80p. (In German). Dep.

Development and processing of BeO moderator materials for a high temperature breeder reactor of the pebble-bed type are discussed. The forming processes for fabrication of BeO spheres are detailed. Physical and chemical properties are described. Irradiation behavior is discussed. 144 references. (M.L.S.)

GENERAL

26129 (AWRE-O-72/68) HOLOGRAPHIC MEASUREMENTS OF VIBRATION AMPLITUDES USING POWELL AND STETSON FRINGES. Wall, M. R. (Atomic Weapons Research Establishment, Aldermaston (England)). Sept. 1968. 20p. Dep. CFSTI. UK 4s. 6d.

Preliminary results demonstrated the validity of a zero-order Bessel function fringe shape for holographic sinusoidal vibration fringes. Accurate measurements of the shape of a simple vibrating strip are described. A technique is illustrated for extending the visibility of fringe systems and of maximum useful vibration amplitude capability. (auth) (UK)

26130 (CTC-4) PROGRAMMER'S MANUAL: UCARDS UNION CARBIDE AUTOMATIC ROUTING AND DESIGN SYSTEM FOR PRINTED CIRCUIT BOARDS. Jamison, J. F. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). Apr. 30, 1969. Contract W-7405-eng-26. 299p. Dep. CFSTI

UCARDS is a computer aided design system for producing component layout, conductor layout, and other aids to the fabrication of printed circuit boards. This manual is intended to be a guide for implementing and maintaining the system. (auth)

26131 (CTC-11) ON RESTRICTED NON-LINEAR DIRICHLET PROBLEMS. Lick, Dale W. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). Apr. 9, 1969. Contract W-7405-eng-26. 17p. Dep. CFSTI.

The Dirichlet problem was considered for the equation $\Delta u = f(P,u)$, where Δ is the Laplacian operator, $P = (x_1, \ldots, x_n)$ and f is non-linear. Most results for this kind of problem require certain smoothness conditions on f for all u. However, in many applied problems, such as those arising in non-linear diffusion or heat generation studies, the physical significance of u or the form of f may limit the set of acceptable values for u. The purpose of this paper was to investigate such restricted problems. (auth)

26132 (CTC-13) MOMENTS OF MOMENTS AND FREQUENCIES. EXPECTATION OF POWER-SUMS RELATED TO CATEGORIZED DATA. Bowman, K. O.; Shenton, L. R. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). Apr. 21, 1969. Contract W-7405-eng-26. 39p. Dep. CFSTI.

Let the population being sampled be classified into a finite or denumerable set of classes, the probability of an occurrence in the i^{th} class being p_i, and n_i being the observed frequency in this class out of a sample of n. The problem considered is the expectation of any ϕ-product such as $\phi_1^{\alpha}\,\phi_2^{\beta} \ldots \phi_s^{\omega}$, where ϕ_s is a quantic of weight s in the random increments $\epsilon_i = n_i/n - p_i$. If the total weight of the product $\phi_1^{\alpha}\,\phi_2^{\beta} \ldots$ is not too high, an operational procedure is given which derives the required expectation by a polarization process applied to a power of ϕ_1. Another procedure is described which applies to those ϕ-products, say Φ_s which are such that $E\,\Phi_s = \sum_{\lambda=1}^{m} A_\lambda/n^\lambda$, where the A's are independent of n_i and $m - 1 \neq 4$. This approach has been digitalized and should be useful for many applications which do not involve the power of n^{-1} higher than the fifth. (auth)

26133 (GEPP-56) COMPUTERIZED APPROACH TO BASIC WORK SAMPLING APPLICATIONS. Streit, P. L. (General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.). Dec. 31, 1968. Contract AT(29-2)-656. 37p. Dep. CFSTI.

A system is described which eliminates manual calculation and applies accepted binomial probability approximations to work sampling data recorded in computer readable form. Separate data card designs permit the recording of 30 observations of work station oriented or mobile work groups in a single data card. Ten or eleven flexible categories of observations common to up to 6 subgroups within a study are available. Any number of studies may be processed concurrently. File size is reduced to a maximum of 7 record cards per study after each run. User options ensure design freedom, progress and validity monitors, and termination of sampling at the earliest practical time. Sampler productivity gains of 25 to 50 percent are realistic depending upon the situation. (auth)

26134 (IN-1218) NUCLEAR TECHNOLOGY BRANCH YEARLY PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1968. Heath, R. L. (ed.) (Idaho Nuclear Corp., Idaho Falls). Dec. 1968. Contract AT(10-1)-1230. 357p. Dep. CFSTI.

A separate abstract was prepared for each of the five major sections of the report. Sections not treated in separate abstracts concern university cooperation programs, publications, and personnel activities. (D.E.B.)

For abstracts of individual sections see: 24426, 25428, 25901, 26086, and 26121.

26135 (JAERI-5011(Vol.4)) TECHNICAL PUBLICATIONS BY JAERI STAFF FROM JANUARY 1968 TO DECEMBER 1968. (Japan Atomic Energy Research Inst., Tokyo). Mar. 1969. 44p. Dep.

Approximately 500 journal papers, meeting papers, reports and books are given, which have been published by personnel of JAERI from January 1968 to December 1968. The contents for each entry include the title, language in which it is written, author(s), and journal name or origin. A list of the patents, originating at JAERI, including both Japanese and other patents, is also given. (auth)

26136 (LA-DC-9622) TAF: STEADY STATE, FREQUENCY RESPONSE, AND TIME RESPONSE SIMULATION PROGRAM. Springer, Thomas E.; Farmer, Otis A. (Los Alamos Scientific Lab., N. Mex.). [1965]. 30p. (CONF-681207-3). Dep. CFSTI.

From Digital Equipment Computer Users Society Conference, San Francisco, Calif.

The TAF digital computer program can be used to study the behavior of any system that can be represented by a group of first-order non-linear differential equations. Steady state, frequency-response and time response solutions may be obtained by coding only the derivatives of the system. The code consists mostly of closed subroutines that only require input data. Two user coded subroutines in the FORTRAN IV language are needed to define the input parameters and the derivatives of the system. (auth)

26137 (NYO-3532-8) HIGH ACCURACY, MANY-ELECTRON WAVEFUNCTIONS FOR NOBLE GAS MOLECULES. Progress Report, November 1, 1967–October 31, 1968. Allen, Leland C. (Princeton Univ., N. J.). Apr. 9, 1969. Contract AT(30-1)-3532. 8p. Dep. CFSTI.

A computer program was developed for carrying out rigorous, ab initio, many-electron Molecular Orbital, Molecular Orbital plus configuration interaction, and valence bond electronic wavefunctions. Studies were made on argon atom orbitals and repulsive energy surfaces. (M.C.G.)

26138 (ORNL-4402) PARAMETERS FOR THE CALCULATION OF OSMOTIC AND ACTIVITY COEFFICIENTS AND TABLES OF THESE COEFFICIENTS FOR TWENTY-TWO AQUEOUS MIXTURES OF TWO ELECTROLYTES AT 25°C. Rush, R. M. (Oak Ridge National Lab., Tenn.). Apr. 1969. Contract W-7405-eng-26. 71p. Dep. CFSTI.

Parameters are given for the calculation of osmotic and activity coefficients for 31 aqueous mixtures of two electrolytes at 25°C. In addition, tables of osmotic and activity coefficients are given for 22 of these mixtures. (auth)

26139 (SC-CR-69-3084) ORGANIC ELECTROLYTE BATTERY. Final Report. McDonald, Guy D. (Globe-Union, Inc., Milwaukee, Wis.). Apr. 1969. Contracts 58-0690; 58-4116; 58-5214. 62p. Dep. CFSTI.

For Sandia Labs., Albuquerque, N. Mex.

A technique was developed to rapidly screen potential cathode materials for a wide temperature range, −54 to +121°C, nonaqueous electrolyte battery. This screening technique, involving the testing of thin anodic films of materials, was applied to the chlorides, oxides, and fluorides of silver, copper, nickel, cobalt, iron, manganese, and chromium. The requirement that an anodic film of the material could be formed, which was stable in at least one of the five organic test solvents, limited the applicability of the screening technique. Of the materials to which this technique could be applied, cobalt oxide, iron oxide, and copper oxide failed to establish a reproducible open circuit potential in nonaqueous solvents. Silver chloride, silver oxide, and cupric fluoride, gave potentials in a nonaqueous medium that were reproducible to within one millivolt and behaved reversibly to the application of anodic and cathodic potential (10 mV). Silver chloride and silver oxide were shown to be able to produce considerably more current at the same polarization from open circuit potential than copper fluoride and should therefore be more extensively investigated as electrode materials for a wide temperature range, nonaqueous battery. Evaluation of the materials that could not be studied as thin anodic films will have to await the development of suitable macro electrode techniques. (auth)

26140 (SLAC-96) USE OF MAN-MACHINE INTERACTION IN DATA-FITTING PROBLEMS. Smith, Lyle B. (Stanford Linear Accelerator Center, Calif.). Mar. 1969. Contract AT(04-3)-515. 291p. Dep. CFSTI.

The possibility of providing useful tools for numerically solving scientific problems in an on-line environment is explored. The development of such tools is then exemplified by interactive sys-

tems written for an IBM 2250 display console (CRT). Least squares data-fitting and related problem of numerical functional minimization is chosen as an example of a problem area which can benefit from on-line graphical interaction. Interactive systems can be designed for various levels of user sophistication. A system that can be useful to persons with any level of programming ability or training has to be designed to lead a user through the problem solving process. This can be accomplished by allowing the user to select from various options at each stage in the problem solution rather than requiring him to specify steps to the computer. The design of PEG, an on-line least squares data-fitting program, embodies this easy-to-use design philosophy. Several other aspects of the design of interactive systems are discussed and exemplified by the design of PEG. PEG is related to other existing and proposed systems for on-line solution of mathematical problems. A brief survey of other systems is included. The PEG system includes orthogonal polynomials, Fourier approximations, spline functions (with fixed or variable joints), and user defined functions as fitting functions. The user defined functions and spline functions with variable joints are non-linear problems whereas the other functions involve linear least squares problems. Fortran was used to do all the implementation except for a few 2250 routines coded in assembly language. The use of a high level procedural language such as Fortran, Algol, or PL/1 eases the implementation of such systems. Also, by coding in Fortran we achieve some degree of machine independence because of its widespread use. Results are given for problems on which PEG has been used successfully. One problem involves using polynomial or spline functions to obtain a fit to empirical data. Two other problems involve user defined functions: a sum of Breit–Wigner terms and a sum of Gaussian curves. Special consideration is given to the problem of fitting an ellipse to empirical data. The ellipse problem is treated both as an implicit function fitting problem and as a linear least squares problem. The implementation of an interactive minimizer using a Gauss–Seidel type method is described. This illustrates how on-line graphics can show round-off error and aid a user in locating subsidiary minima. The interactive minimizer is used by the PEG system as an alternative or supplement to the direct search minimization used on non-linear problems. Finally, an interactive data-fitting program which employs the maximum likelihood method is given. This program uses the interactive minimizer to perform the maximization and produces on-line contour plots for examination of results. A problem involving empirical data has been solved using this program. (auth)

26141 (UCLA–10-P-14-65) DEVELOPMENT OF A META-COMPILER CONTAINING LIST-PROCESSING CAPABILITIES. Gardner, Robert Irving Jr. (California Univ., Los Angeles. Dept. of Engineering). Dec. 1968. Contract AT(11-1)-Gen-10. 117p. Dep. CFSTI.

A special list-processing system has been developed and integrated with a metacompiler. The special list-processing system is based on directed graph structures which can be created and manipulated by a programmer. Each directed graph structure is characterized by a set of nodes linked together by arcs. The combination of a list-processing facility and metacompiler has been found to be a useful laboratory tool for implementing special-purpose, high-level language translators and compilers and for implementing computer program optimizing systems. (auth)

26142 (UCLA–10-P-14-71) LOGIC DESIGN AND INTERFACE OF A LINCOLN WAND SYSTEM. Makranczy, T. A. (California Univ., Los Angeles. School of Engineering and Applied Science). Feb. 1969. Contract AT(11-1)-Gen-10. 130p. Dep. CFSTI.

A description of the design and interface of a 3-dimensional graphic input device is presented. The system functions as an auxiliary input device to a general purpose digital computer. The Lincoln Wand uses a sonic delay technique to periodically sample the position of a pen-sized stylus. The system described was specially designed to interface with the Graphics Station developed jointly by the Variable Structure Computer, Computer Instrumentation and Digital Technology projects at UCLA. The basic operating principles are presented and pertinent characteristics of the SDS Sigma 7 Computer and Graphics Station are described. A chapter is devoted to familiarizing programmers with the system's software and operational characteristics. The control logic is explained with logic diagrams, timing charts and logic equations. A data reduction algorithm and assembly language program are described. This program was timed using a software timing technique. The technique and results are furnished. Analysis of errors and resolution of the device are also treated. (auth)

26143 (UCRL–50474) MOESSBAUER EFFECT IN SOLID KRYPTON. Gilbert, Keith G. (California Univ., Livermore. Lawrence Radiation Lab.). Sept. 4, 1968. 64p. Dep. CFSTI.

A theoretical and experimental investigation was conducted by the lattice dynamics of solid krypton (Kr), in both cases determining atomic mean square displacement $\langle x^2 \rangle$ as a function of temperature. In many ways, rare gas crystals are the simplest solids, and so might be expected to yield fundamental lattice dyanmics. In the experimental work, $\langle x^2 \rangle$ vs temperature is obtained by using the Moessbauer effect to measure the recoilless fraction in solid Kr over the temperature range of 5 to 85°K. In the theoretical work, $\langle x^2 \rangle$ vs temperature is calculated from the spatial distribution function, itself determined by a Monte Carlo calculation using the Lennard-Jones potential. This treatment is independent of the harmonic approximation. A second prediction for $\langle x^2 \rangle$ follows from the current version of the phonon frequency distribution function. For all temperatures, the experimental values of mean square displacement (inferred from the recoilless fraction) are 1.5 to 2.5 times the theoretical predictions. This result is in apparent disagreement with measured thermodynamics of solid Kr. A proposed modification of the Kr frequency spectrum which might resolve this difficulty is discussed. (auth)

26144 (UCRL–50565) DETERMINING RELATIVE RESOLUTION ON A SENSITOMETRIC STEP WEDGE. Milochik, Michael (California Univ., Livermore. Lawrence Radiation Lab.). Jan. 2, 1969. 9p. Dep. CFSTI.

A simple and quick method, developed for determining the relative resolution of a film/developer combination as a function of exposure, is described. The film being tested sees a target containing 21 three-line sets of 0.5-, 1-, and 3-mil lines against a 21-step sensitometric wedge. Evaluating films with this setup enables one to do routine sensitometry, granularity study, and resolution study all on one film sample. (auth)

26145 (UCRL–50579) NUMERICAL EQUATION OF STATE FOR ARGON. Johnson, Keith W. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 4, 1969. 15p. Dep. CFSTI.

A numerical equation of state for argon is developed by fitting shock-wave data and low-pressure isothermal data to the form $P(\mu,E) = A_1(\mu + 1)E + A_2\mu^2 + A_3\mu^3 + A_4\mu^4 + A_5E\mu^2 + A_6E\mu^3$, where P is the pressure, μ is the relative compression, E is the internal energy, and A_i is a coefficient. Release isentropes and rarefaction velocities are calculated from this equation. An example with one isentrope demonstrates that a series of shocks from liquid argon can drive a thin copper plate to a mass velocity that is 75 percent greater than that obtainable with a single shock having the same initial strength. (auth)

26146 (WAPD-TM–783) COMPUTER PROGRAM BL47 FOR PLOTTING PLANE STRUCTURES. Friedrich, C. M.; Cullens, J. J. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Feb. 1969. Contract AT(11-1)-Gen-14. 42p. Dep. CFSTI.

BL47 is a plotting routine designed for plane structures that are to undergo stress analysis. Points and lines are input in various parametric forms, and curved segments are drawn between given points along the given lines. The program may be used as a drafting tool to construct engineering drawings. (auth)

26147 THE SIGNIFICANCE OF ELECTROENCEPHALOGRAPHIC TESTS IN EVALUATING NUCLEAR REACTOR OPERATOR PERFORMANCE FITNESS. Strambi, E. G. Fis. Sanit. Prot. Radiaz., 11: 133-41(1967). (In Italian). (RT/PROT(68)7).

Use of the electroencephalograph (EEG) for determination of operator fitness is proposed as part of the regular physical exam. It is argued that the EEG can pinpoint possible human error factors, to which the majority of reactor accidents have been attributed. (M.L.S.)

CORRECTION

NSA Vol. 23, No. 9, Abst. No. 16373, line 4 should read: Williams and Wilkins Company, 1968. 206p. $10.50.